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ILLUMINATION.

The interesting discussion which took place at the meeting of the American Institute of Electrical Engineers last week is concluded in this issue. While no very definite results were suggested, still the collection of different points of view exhibited in these papers makes them of unusual interest. The subject of illumination is one that immediately concerns and interests electrical engineers. One of the most important uses of electricity is in the generation of light, and certainly no information that tends to make plain better methods for utilizing light thus generated can fail to be of high value.

The discussion of this subject has just begun. It is believed that the next few years will see much more lively interest taken in it and a considerable degree of time expended in research and experiment in this direction.

THE LESSONS OF THE NEW YORK CENTRAL TUNNEL DISASTER.

In the tunnels approaching the Grand Central Station, in New York, there occurred last week a disastrous rear-end collision, resulting in the death of a number of persons and the more or less serious injury of many others. At present an official enquiry is going on to determine the cause of the accident so far as may be possible, and in advance of this it is gratuitous to assume to assign any responsibility or to look for any reason for the mishap beyond the very evident and patent fact that it was due to an engine-driver having failed to observe a danger signal.

For some time past the tunnels in question have been the subject of a controversy, in which various citizens and newspapers on the one side have urged the expediency and importance of immediately installing an equipment for electric traction, while the interested railroad companies on the other have maintained that the complexity of service, incident to the business of the large terminal station, renders this method of traction inexpedient and even impossible.

The fact that for years past a total of more than six hundred trains a day have been safely and successfully handled over the four tracks in these tunnels, into and out of a restricted, complex and inadequate terminal yard, and supplying the through and suburban services of three radiating lines of railway, stands as a testimonial to the high skill and great ability of the engineering staffs of the railway companies. Probably nowhere in the world is there a more difficult and complex problem in railway operation than is presented by this terminal section from Mott Haven to the Grand Central Station. The facts seem to be, as nearly as they may be appreciated at this time, that the practical limit of operation by means of steam locomotives has been reached, if not in some degree already exceeded.

Concerning the question of electrical equipment it seems impossible to hold more than one view. Such equipment is not only entirely practicable, but it is believed and is even demonstrable that its introduction would solve numerous problems now existing, and would tend eventually and very shortly to create an additional influx of business that would more than pay for the cost of the improvement. The tunnels have been, since the business conducted in them has grown to such enormous proportions, very badly ventilated, and especially during the rush hours of morning and evening when trains follow each other in rapid succession are filled with smoke and vapor to such a degree as to make it very difficult to see the ordinary signals consisting of various colored lights. This fact illustrates one of the limiting conditions which surround the operations of steam railroads equipped with signaling devices such as are in common use.

The fact is that with all systems of visual and audible signals, such as semaphores, lights, bells and torpedoes, the connection between the setting of the signal and the control of the train is necessarily through the physiological mechanism of the engine-driver. He must see or hear the signal, interpret it correctly and act accordingly. On this account he becomes the most important link in the chain of apparatus controlling the movement of the train upon which the despatcher has to rely for the execution of his order. No matter how elaborate and perfect may be the automatic and interlocking mechanism employed in displaying such signals, the personality of the engine-driver is always a factor which must be considered.

Leaving out every other consideration of expediency in connection with an electric traction system operated from fixed conductors paralleling the track, the fact that such a conducting system can be interlocked with the signal system so as to de-

prive a train of its power and set its brakes should it be driven past a danger signal adds an element of safety which can not exist on a steam railroad. This consideration, important as it is, is of no more vital significance than others; for example, the possibility of maintaining a clean, well ventilated and well lighted subway in place of the present tunnels filled with noxious smoke and vapor.

The subject of the equipment of this important tunnel is far too extensive to be discussed in the space available here with anything like thoroughness. It is evident that an electrical system would have rendered such an accident as that which has just occurred much less liable to happen, although no method of operation which depends upon the human element to translate signals into action can ever be absolutely and perfectly secure. Still, the possibility of controlling the train itself by means of the apparatus which operates the signal should not be lost sight of in the construction of the system which will undoubtedly now be installed upon this section of railway.

The principal lesson to be derived from the calamity of last week is that a section of railway has definite limiting conditions when operated by steam power, and that when the pressure of traffic makes it necessary to exceed these, another and more satisfactory form of motive power should be sought. This can be found to-day in electric traction.

THE CARNEGIE INSTITUTE.

The foundation at Washington of an institute for the advancement of scientific research has been made through the enlightened munificence of Mr. Andrew Carnegie. The impression seems to prevail that this institute will in some degree partake of the nature of a university, but this is not true, and instead of adding another to our already long list of well equipped institutions of learning, Mr. Carnegie has established a foundation which must, in the nature of things, prove of the most direct, immediate and extensive benefit to American science.

It is a curious fact that, while in this country we have gone further in engineering, which means the application of science to practice, than any other people, yet in the last two or three decades we have fallen behind other nations in the advance of pure science. If we look to see who are the leaders of thought in various departments of scientific activity, we find that nearly all of them are European. This is true not only in medicine, biology and chemistry, but, singularly enough, also in electrical physics and in practically every science except astronomy. Electrochemistry, the newest development of electrical application, is practically due to Van't Hoff, a Dutchman; Arrhenius, a Swede, and Raoult, a Frenchman. Electrical physics began with Faraday, was nurtured by Maxwell and Kelvin, and seems to be advancing with tremendous strides through the labors of J. J. Thomson, all of them Englishmen. From Bunsen to Berthelot the science of chemistry seems to have made its home in France and in Germany.

The reasons are not far to see: In England the Royal Institution has fostered the labors of such men as Faraday, Thomson and Dewar. In France the College de France has given opportunity for research of all kinds, while both government and citizens united in establishing the Pasteur Institute, which may be looked upon as the source of advancement in the recent science of biology. In Germany the conditions surrounding university life are such that professors have both abundant leisure and almost limitless opportunity to pursue purely scientific research.

In this country things have been different. Our university professors have been compelled to teach, and up to the time of Mr. Carnegie's most wise and far-seeing foundation there has been no analogy to the institutions mentioned above. Very few men have enjoyed the combination of leisure and opportunity necessary to the prosecution of scientific research. We are a busy people, and our national spirit has been evident even in our universities. Mr. Carnegie has given the opportunity; nobody will believe that we can not produce men to avail themselves of it with credit and worthiness.

ELECTRIC TRACTION ON THE MANHATTAN ELEVATED RAILWAY.

On January 9 the formal opening of the electrical service on the Manhattan Elevated Railway, of New York city, took place, the occasion being signalized by the passage of a train containing invited guests over the length of the Second avenue line of the elevated structure. In our last issue was given at some length a description of the superb generating plant which furnishes electrical energy for the operation of this important system of railways.

It is worthy of note that the same system of elevated railways was the theatre of the first experiments on heavy electric traction. In 1886, 1887 and 1888 experiments were conducted by Mr. Frank J. Sprague and Mr. Leo Daft with electric motors of large size and power, and the results achieved by these early experiments, considering the state of the art at that time, were most astonishing and significant. As other workers in other fields have sometimes been, they were years ahead of their time, but it should not be forgotten that the system developed by each of these experimenters of fourteen years ago would have been entirely satisfactory in practice.

The system lately installed is that which has become apparently standard in this country for railways of considerable length. Electrical energy is generated in the form of high-pressure polyphase currents at a steam plant situated with reference to the easy reception of fuel and access to condensing water. These currents are transmitted to a number of substations where they are reduced in pressure and converted by means of synchronous converters into direct current of about five hundred volts tension, and thence fed to near-by sections of the conducting system and track. Direct-current motors are used on the trains, these possessing marked advantages of powerful starting torque and the ability to impart high acceleration to the train. Apparently the question of operating these railways by polyphase currents directly was not considered.

The results of the electrical equipment may easily be foreseen. The most immediate consequence will be an increase in the capacity of the lines of some twenty per cent and the ability to increase the capacity considerably beyond this figure. At the same time many of the objections incident to the operation of steam locomotives in the city will be removed and it is believed that additional patronage must follow the introduction of the cleaner, quieter and swifter electric service.

The engineering staff of the Manhattan railways is to be highly congratulated upon the solution it has adopted for the somewhat difficult problem in hand, and especially for the construction of a power station of such an efficient and satisfactory type as that which has just been put in operation.

THE THEORY OF ALTERNATING DYNAMO ELECTRIC MECHANISMS—LII.

BY W. ELWELL GOLDSBOROUGH.

THEORY OF THE ALTERNATOR.

In Fig. 128 is shown diagrammatically the arrangement of the coils on the armature of a single-phase alternator. In the position shown, the teeth, T, are opposite the poles, and accordingly the greater part of the magnetic flux which passes from the poles into the armature threads through the coils which surround the teeth. As the armature rotates, the coils advance with the teeth, and assume new positions relatively to the poles; for instance, Fig. 129 shows the position of the teeth after they have been advanced ⅛ of a cycle; Fig. 130 shows the teeth after they have been advanced ¼ cycle; Fig. 131 shows the position of the teeth after they have been advanced ⅜ cycle. When the teeth have moved forward to the position shown in Fig. 130, none of the flux which passes from the poles into the armature threads through any of the coils. This, then, is a position of zero flux in the coils, although the amount of flux passing from the north poles into the armature, and through it into the south poles, remains practically constant at all times.

It has been found in practice that the variation in the number of lines of force threading the coils is closely as a sine function, and discussions of the theory of these machines are based on this assumption. Suppose, then, that when the coils occupy the position shown in Fig. 128 relatively to the poles Φ_0, lines of force are enclosed by one coil. This will be the maximum value of the pole flux at any time penetrating a coil. If, now, ϕ_0 represents the instantaneous value of the flux at any time penetrating one armature coil, by assumption

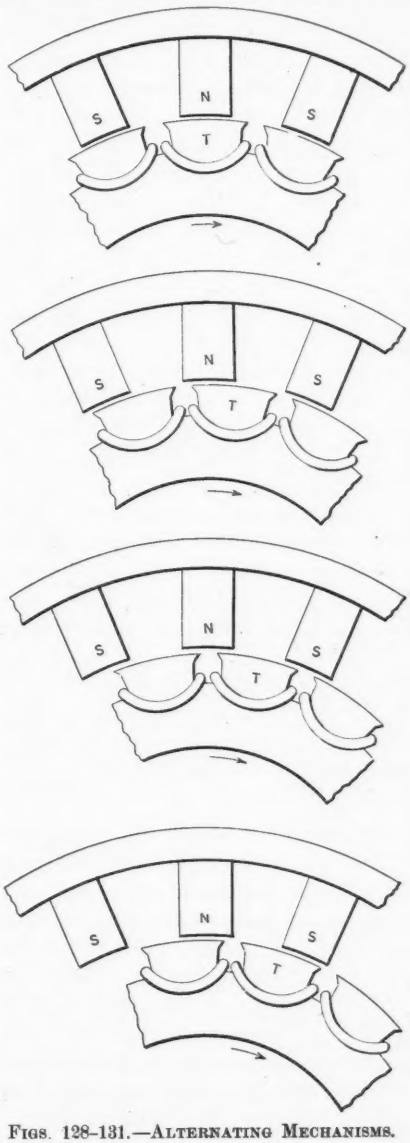
$$\phi_0 = \Phi_0 \cos \omega t. \qquad (35)$$

Starting from a positive maximum in the position of Fig. 128, this function becomes zero for the position of the teeth shown in Fig. 130, and rises again to a negative maximum when the teeth reach a position ⅛ of a cycle in advance of the phase position shown in Fig. 131.

By Farady's law, we know that whenever there is a variation in the number of lines of magnetic force threading a coil, an electro-motive force will be induced in that coil which is proportional to the rate of change in the number of lines of force threading the coil. A decrease in the number of these lines of force induces a positive electro-motive force in the coil, while an increase in the number of lines of force induces a negative electro-motive force in the coil. Accordingly, if e_0 be taken to represent the instantaneous value of this electro-motive force,

$$e_0 = -\frac{d\,\phi_0}{d\,t} = -\Phi_0\,\omega \sin \omega t \qquad (31)$$

from which we see that the electro-motive force induced in the coils varies as a harmonic function when the flux variation



FIGS. 128–131.—ALTERNATING MECHANISMS.

through the coil is a harmonic function. Moreover, when $\sin \omega t$ becomes equal to unity

$$e_0 = -\Phi_0\,\omega = E_0$$

equals its maximum value; therefore

$$e_0 = E_0 \sin \omega t. \qquad (3)$$

Again,

$$\phi_0 = \Phi_0 \cos \omega t = \Phi_0 \sin (\omega t + 90°) \qquad (36)$$

therefore, ϕ_0 is 90 degrees in advance of e_0; and, accordingly, e_0 passes through its maximum value when the coils are in the position shown in Fig. 130, and through its zero value when the coils occupy the position of Fig. 128.

In considering the theory of the alternator, we can readily develop a diagram illustrating the reactions which take place by following out the simple mathematical relations between magnetism and electro-motive force. For any coil of wire possesses two characteristic qualities; first, it has an ohmic resistance due to the electrical resistance of the metal of which it is composed; and, secondly, it has inductance, owing to the magnetic field which any current threading it produces. If, now, we assume that an armature is revolving at n revolutions per second, and that its coils, connected in series, are closed through a circuit of resistance, r_1, the resistance and inductance of the armature coils themselves being r_a and x_a, respectively, a current (i) will begin to circulate through the armature coils and the external resistance r_1. The equation of this current, in terms of the constants of the circuits and the maximum value E_0 of the electro-motive force developed in the coils, is

$$i = \frac{E_0}{\sqrt{(r_a + r_1)^2 + x_a^2}} \sin\left(\omega t - \tan^{-1}\frac{x_a}{r_a + r_1}\right) \qquad (56)$$

which expresses the instantaneous value of (i) as soon as a condition of cyclic stability has been attained. Equations (3), (36) and (56) are the general equations that cover the working of alternating-current dynamos supplying power to non-reactive circuits, and we will subject them to graphical analysis.

Imagine a circuit, such as that illustrated by Fig. 132, to be subjected to the influence of a simple harmonic electro-motive force generated in the armature of an alternator having a constant armature inductance for all values of the armature current, a constant field excitation and a constant speed. Under these conditions the *effective* value of the electro-motive force at the collector rings of the alternator, just before the circuit is closed, is

$$E_0 = \omega\,\phi \div \sqrt{2} = \sqrt{2}\,\pi\,\phi$$

which is represented by the vector OA_0 in Fig. 133. The vector OM_0 is laid off at right angles to OA_0, to represent the value of the maximum flux enclosed by one of the armature coils. It is drawn 90° in advance of the electro-motive force OA_0, which it induces, in accordance with the relation established in equations (3) and (36).

To render wood flexible, and at the same time non-inflammable, it is coated with or immersed in a six per cent solution of caustic potash or a five per cent solution of caustic soda.

Science Brevities

Disruptive Discharges in Electrolytes—Following the research of Broca and Turchini, M. Bagard, in *Comptes Rendus,* has described a way of obtaining sparks in electrolytes without the use of such powerful batteries. To reduce as much as possible the surface of the terminals, they are made of horizontal metallic threads one millimetre in diameter, insulated up to their immediate extremities with ebonite. In this way a discharge can be obtained with an ordinary electrical machine and two large Leyden jars. The spark has a color depending on the substance in solution; in sulphuric acid it has the color of a discharge in hydrogen.

Electrical Resonance and the Coherer—Mr. Fournier d'Albe says: In his investigations of the electric oscillations of a straight conductor, Herr F. Kiebitz made the observation that a coherer acts most readily when connected up with two wires parallel to the exciter wires, and when the length of the wires attached to the coherer is that of a quarter wave-length each. Hence the coherer shows the maximum action in the node of potential. Slaby, on the other hand, founds the explanation of his system on multiplex space telegraphy upon the opposite assumption, that the coherer is best placed in a ventral segment of the variation of potential. Kiebitz has, therefore, extended his observations and confirmed his formal result. It is evident that the coherer will give the best indications when the greatest possible difference of potential is produced at its ends. Now, if the coherer acted as an insulator of very small capacity, the best arrangement would be to attach wires of length equal to half a wave-length. But if the capacity of the coherer is very great, or if the coherer acts as a conductor, there must be resonance when the length of the attached waves is equal to a quarter wave-length, and this arrangement must be most favorable when placed at the node, although there may be then a minimum potential difference at the ends of the coherer. The author concludes, therefore, that the coherer acts as a great capacity or as a conductor. It probably acts as the former in its original state, and as the latter after the impact of the waves. The author used coherers of iron screws.

Extraction of Sugar by Electric Osmose—Dr. Schwerin, of Munich, has patented a method of extracting and purifying sugar which depends partly on electrolysis and partly on osmose. The cell is divided by a cloth diaphragm, and closed on the one side by a somewhat porous partition of fine copper wire woven with cloth, forming the cathode. In this division the crushed beet or cane is placed, mixed with water; in the other the anode immersed in water. Electrolysis occurs, the metals dissolve and precipitate the acids and coloring matters, and the sugar solution is drawn through the cathode diaphragm, in the wake of the positive current, by electric osmose, and collects in a trough underneath. It is said to be much purified, but still contains the cations, alkalies, bases and some albuminous matters; moreover, to replace simple mechanical pressure by electrical would not seem economical. No details as to cost are given. Some time ago we noticed a similar contrivance by the same inventor, says *Lightning,* for extracting moisture from wood-pulp, peat, fruits, sludges, etc., by means of the liquid convection that sets toward the negative pole. The apparatus consisted of a perforated cylindrical cathode, an interior concentric anode, and an intermediate helical blade to advance the material and break up surface crusts. In several methods of extracting sap from wood, and impregnating it with preserving or fireproofing compounds, it is found that electricity helps the operation considerably, owing to this mechanical carrying action of the current. The same action takes place in electric tanning, of which we spoke last week.

The Induction Coil—As an instance of the fact that the action of the induction coil is as yet very little understood, Lord Rayleigh mentions that there is no *à priori* calculation determining from the data of construction and the value of the primary current even the order of magnitude of the length of the secondary spark, says an abstract in the *Electrician.* This remark applies, of course, only to induction coils worked by a break, and not to transformers. This incompleteness of the theory is due to several causes, such as the departure of the iron from theoretical behavior, the length of time occupied even by the most rapid break, and the capacity of the secondary coil. But for these circumstances the theory would be very simple. Lord Rayleigh advances some new principles, which he proves by somewhat novel means. After pointing out that the energy of charge at the moment preceding the secondary spark can not exceed the energy of the primary current before break, he goes on to state that the available energy of a highly magnetized core of iron is insignificant, especially if the magnetic circuit is nearly or completely closed. The only use of a condenser in conjunction with the ordinary break is to quicken it by impeding the development of an arc, so that when a sufficient rapidity of break can be obtained by other means, the condenser is worse than useless, operating, in fact, in the reverse direction, and prolonging the period of decay to the primary current. To prove this the author has tried to blow up a portion of the primary circuit by electric discharge, but succeeded better by cutting the circuit with a rifle bullet. At a distance of 90 mm. between the terminals no spark could be got when the condenser was in connection. When it was disconnected a spark was observed nearly every shot.

Hydrogen from Silicides—Several processes for the production of silicides in the electric furnace have lately been discovered. A new use for these compounds has been proposed, founded on their decomposition by water in the cold. They are formed by the reduction with carbon in the furnace of any salt of the alkaline earths with quartz or sand, and, being very fusible, readily flow out from the mass. They are by no means, as claimed, new compounds, since Wöhler, in the middle of the last century, discovered magnesium and calcium silicides, the former with acids evolving the spontaneously inflammable hydride, SiH_4. But it is stated the crystallized $CaSi_2$, $BaSi_2$ and $SrSi_2$ prepared as above, yield, with water, a copious and cheap supply of pure hydrogen, leaving hydronides of the alkaline earths, which are of commercial use. In dilute acids, calcium silicide gives "silico-acetylene," Si_2H_2, a yellow crystalline, non-explosive body, dissolving in alkalies with liberation of hydrogen. The demand for the production of hydrogen economically for illuminating purposes is likely to shortly be very large. The South Metropolitan Gas Company, of London, has obtained powers to reduce its standard for gas from sixteen to fourteen candles, in consideration of the employment of incandescent burners, in which the heating qualities of the gas are the most important. For this purpose a mixture with pure hydrogen would be eminently suitable, besides diminishing the content of sulphur. Hydrogen prepared from metals by acids, and even that obtained by ordinary electrolysis, are apt to contain impurities, but the product from calcium silicide, being evolved in alkaline solution, can not contain sulphuretted hydrogen and is said to be perfectly pure. It might be worth while for the gas companies to give attention to this method of electric preparation of hydrogen, says a British contemporary.

Methods of Illumination and Units of Light.

Papers and Discussions at the One Hundred and Fifty-Ninth Meeting of the American Institute of Electrical Engineers, January 3, 1902.

(Concluded.)

WHEN* the arc travels to the edge of the carbons we have a great volume of light from one side, and very little from the opposite side. Under such conditions the photometer would probably show a freak reading of 1,600 to 1,800 maximum candle-power from a lamp which would give

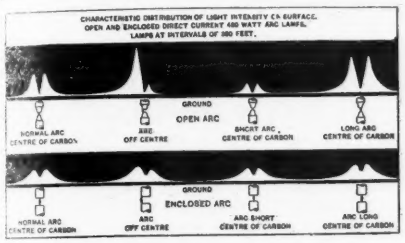

CHARACTERISTIC DISTRIBUTION OF LIGHT INTENSITY ON SURFACE.
OPEN AND ENCLOSED DIRECT CURRENT 480 WATT ARC LAMPS.
LAMPS AT INTERVALS OF 300 FEET.
GROUND
OPEN ARC
NORMAL ARC CENTRE OF CARBON
ARC OFF CENTRE
SHORT ARC CENTRE OF CARBON
LONG ARC CENTRE OF CARBON
GROUND
ENCLOSED ARC
NORMAL ARC CENTRE OF CARBON
ARC OFF CENTRE
ARC SHORT CENTRE OF CARBON
ARC LONG CENTRE OF CARBON

FIG. 4.—CHARACTERISTIC DISTRIBUTION.

about 1,200 when the arc is coaxial with the carbons.

This wandering also takes place in the enclosed arc lamp, but it is not due particularly to the non-homogeneity of the carbons, because a high grade of carbon is employed, but it is primarily caused by the carbons burning flat in a globe practically free from oxygen and the arc wanders of necessity. The variation in the light from this cause is not so great as in the open arc, but it is not altogether pleasant when clear globes are employed.

By using an opal-enclosing globe, the light is balanced and the variation is reduced to a satisfactory degree of steadiness and all shadows are obliterated (Fig. 3).

Flickering Arc—A common complaint against the open arc is the flickering due in a measure to non-homogeneity of carbons, but mainly to the wind blowing the arc about. While the latter cause is not inherent in the arc, it is common practice in America to leave the arc exposed to the wind and as this condition exists it seems reasonable to include it in the comparison.

High grade carbons are employed in the enclosed arc lamp and the arc is thoroughly protected from the wind so that flickering from the above-mentioned cause is entirely absent.

Alternating *vs.* Direct-Current Arc—We are all more or less familiar with the low light-giving efficiency of an alternating open arc lamp. By the introduction of the enclosed lamp with its long arc and opal globe the difference in lighting efficiency between alternation and direct current has practically disappeared, so that the alternating enclosed arc has about the same illuminating value as a direct-current enclosed arc of equal watts.

*Conclusion of Mr. W. D'A. Ryan's paper on "Street Illumination and Units of Light."

It will be observed from the curves that the alternating arc does not give so high a candle-power in any direction as the direct arc, but the distribution is slightly better and the effective illuminating value of the two lights at a point midway between lamps is about equal.

Small *vs.* Large Units—In lighting a street we strive to light it uniformly, so as to approach a moonlight effect. The employment of small units toward this end forms the basis of a most interesting investigation.

A photometer can not be relied upon to give sufficiently accurate results for such comparisons, but I have found a small instrument called a "Luminometer" very satisfactory. This instrument, while not a scientific piece of apparatus, is of considerable practical value, and it is used to determine the maximum distance a lamp will project a given illumination. A standard illumination of 0.006 of a candle foot was adopted throughout the

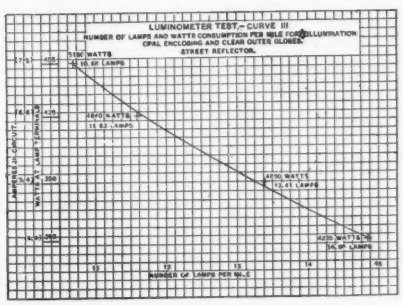

LUMINOMETER TEST.—CURVE III
NUMBER OF LAMPS AND WATTS CONSUMPTION PER MILE FOR ILLUMINATION
OPAL ENCLOSING AND CLEAR OUTER GLOBES.
STREET REFLECTOR.
NUMBER OF LAMPS PER MILE

FIG. 5.—LUMINOMETER TEST.

tests. For convenience this was designated "star six illumination," and this convention is employed in all the diagrams. Tests taken on different nights and with different observers checked within two or three per cent of the mean, and the results can be relied upon as being sufficiently accurate for all practical purposes.

It is quite impossible to lay down a fixed rule for the number of lamps which should be installed per mile, as the location is determined largely by the distance between cross streets, the amount of light required and other local conditions.

Nevertheless, data on the relative lighting distance of various units can be used to advantage.

The accompanying diagrams show the relative lighting distances of 285, 350, 425 and 485-watt alternating enclosed arc lamps. The lighting distance efficiency of these lamps in terms of the smallest unit is, respectively, 100, 90.2, 85.7 and 81.7 per cent.

For the "star six illumination" midway between lamps we would install 10.7—485-watt units, or 14.9—285-watt units per mile.

The former would consume a terminal wattage of 5,180 and the latter 4,235, resulting in a saving of nearly 1,000 watts per mile, with the advantage of four more brilliantly illuminated areas in the interval. Further, for 5,180 watts per mile we could install 18.2—285-watt units, which would give us relatively eight more brilliantly illuminated areas in the interval for the same expenditure of energy and with more than star six illumination midway between lamps, therefore, from a light distribution point of view the advantage of the small unit is established.

While I am not prepared to state that a 285-watt lamp is the lowest practical arc unit, still I believe that this is about as small as can be satisfactorily operated for street lighting. I can say, however, that the argument for small units does not apply to incandescent lamps, because one of the essential requirements for good lighting is the illumination of buildings and other objects on the street to a considerable height above the ground. This requirement is fulfilled by arc lights which flood the buildings with light and thus produce a general diffusion, giving the street an illuminated appearance impossible to obtain with incandescent lamps, even when placed very high and at such short intervals as to make their use prohibitive from a point of economy. Moreover, the light from incandescent lamps, in common with all comparatively low-temperature sources, lacks the luminosity or brilliancy obtainable from the electric arc, and it therefore can not encroach upon the arc where a considerable

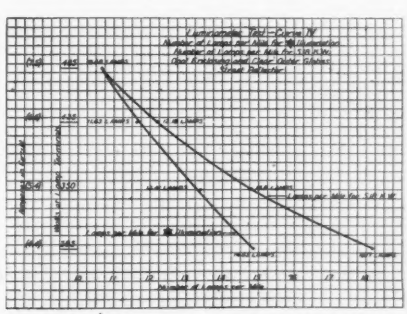


FIG. 6.—LUMINOMETER TEST.

volume of light is required, although it fulfills in a very satisfactory manner a street lighting field essentially its own.

From the foregoing we draw the following conclusions:

First—Open arcs give a higher maximum candle-power than enclosed arcs of corresponding wattage, but the maximum candle-power is in an undesirable direction and the

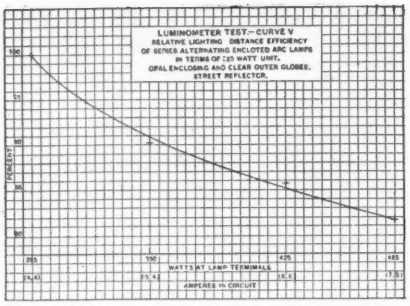

LUMINOMETER TEST.—CURVE V
RELATIVE LIGHTING DISTANCE EFFICIENCY
OF SERIES ALTERNATING ENCLOTED ARC LAMPS
IN TERMS OF 125 WATT UNIT.
OPAL ENCLOSING AND CLEAR OUTER GLOBES.
STREET REFLECTOR.
WATTS AT LAMP TERMINALS
AMPERES IN CIRCUIT

FIG. 7.—LUMINOMETER TEST.

lowing short paper by its author, Mr. S. Everett Doane.

SOME COMMON FAULTS IN EXTERIOR ILLUMINATION.

BY S. EVERETT DOANE.

General illumination can conveniently be considered from two points of view.

First—The actual distribution of light to the object illuminated.

Second—The value of this illumination to the observer.

We can accurately express the value of the first, but can speak only in general terms of the second.

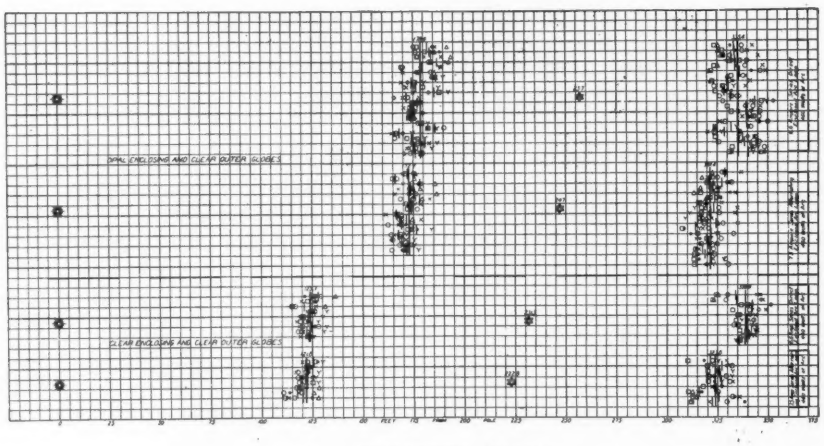


FIG. 8.—LUMINOMETER DIAGRAM.

light fluctuates through wide limits. Enclosed arcs give a higher candle-power through the most useful angle from say three to ten degrees below the horizontal. The light from the enclosed arc is more uniform and steadier and generally superior from an illuminating point of view to open arcs.

Second—Direct-current enclosed arcs produce slightly higher candle-power than alternating enclosed arcs of corresponding wattage, but so far as the illuminating value is concerned the two lamps are on a fair basis of equality, both being superior to the direct-current open arc.

Third—Small unit arcs will illuminate proportionately greater distances than large units for a given expenditure of energy.

Fourth—Incandescent lamps do not illuminate brilliantly to a sufficient height above the street surface to produce the effect of good lighting and are therefore not comparable with arc lights.

In justice to the open arc I wish to state that if we follow European practice, as carried out in large cities, of installing lamps at short intervals, say 80 to 175 feet apart, and use more complicated lamps, which work within closer limits when carefully attended to, burn high-grade carbons, protect the arc from the wind and use opal globes, the advantage of the enclosed arcs over open, from a light distribution point of view, will somewhat disappear.

Aside from the mere question of light, however, there are other arguments for the enclosed arc, particularly with reference to maintenance, convenience and cost of operating, which would throw the balance in its favor even if the open arc were raised to an equal illuminating plane.

Mr. Ryan's paper was followed by a somewhat humorous abstract of the following short paper by its author, Mr. S. Everett Doane.

Much has been said about the first and but little about the second, yet the second is the practical end for which all illumination is designed.

Whether or not the source of light is in range of the observer's vision largely influences the second value.

The contrast between the source of light and its environment is all-important. A farmer's barn lantern will completely blind one to the road beyond when the night is black and the vicinity not otherwise illuminated, whereas an arc lamp backed by a white building may be a fairly satisfactory source of light.

I had occasion during many of the evenings last summer to ride over the country roads near my home, and I had plenty of occasion to notice their illumination. It was my observation that the best lighted towns in my vicinity used kerosene lamps situated at the side of the roads among the tree trunks.

Many and many a time when riding toward an arc lamp have I kept my place on a highway by guiding myself by the shining rail of the street railway track, absolutely unable to tell from the road-bed of shadows what was before me. Actual observations of this character make it clear that the amount of light actually delivered to a road-bed is only a part of what we must consider.

If the source of light must from its character be so placed that the observer is blinded to the road, it avails little as to the candle-power of that source.

An arc lamp usually must be so placed that its light may shine in one's face in

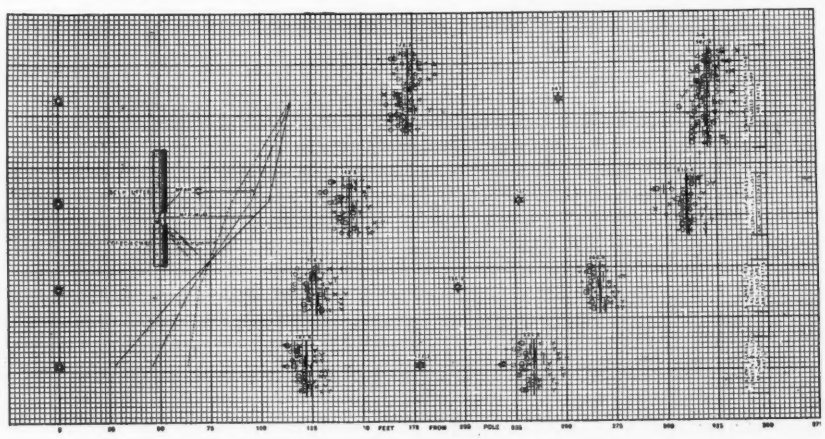


FIG. 9.—LUMINOMETER DIAGRAM.

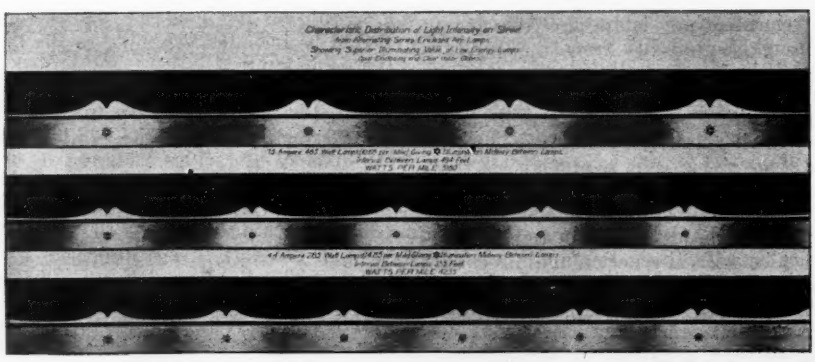


FIG. 10.—CHARACTERISTIC DISTRIBUTION OF LIGHT INTENSITY.

order that the light may shine along the road.

Light delivered from a lamp near at hand is much to be preferred to light delivered from a lamp so far away that the rays of light reach the ground at a small angle. Such light magnifies every hummock and equally shadows insignificant hollows and gulleys deep enough to be dangerous.

It would be better to have half the illumination and be able to see the bottoms of the hollow spots.

One of the recent papers on arc lamps spoke of their value in illuminating the houses and trees, and presumably the landscape, where there are no houses and trees.

The interest in this observation lies in the thought that the greater the candle-power, and the more infrequent the lamps, the smaller the portion of the total light shed upon the ground which actually reaches the roadway.

The Massachusetts state roads are uniformly twenty feet wide. The country roads rarely exceed thirty feet in width. City roads of Massachusetts are required to be forty feet.

Arc lamps, located respectively 200 feet, 300 feet and 400 feet apart are evidently intended to illuminate plane areas about 31,500, 70,000 and 125,000 square feet in extent.

A twenty-foot road crossing this area will receive about 12.7 per cent, 8.6 per cent and 6.4 per cent respectively of the light delivered to the ground.

A forty-foot road will receive twice this percentage, of course, but as the twenty-foot width is all the average rider ever notices the illustration will answer.

From this it is very apparent why it is wise that lamps of reduced candle-power be placed closely together.

From this same illustration it will be seen that lamps placed 200 feet apart, consuming one-half the energy, can be of one-half the efficiency and still give him equally efficient illumination and, what is more to the point, will deliver their light from a more advantageous direction.

One of the best illustrations of suburban street lighting by arc lamps which comes to my mind is on the Boulevard from Boston to Auburndale. The Boulevard is really two separate roads with a continuous narrow park between and the arc lamps are in the middle of this park. so that they may be said to be in a field adjoining the roads.

Why, with all these drawbacks. are arc lights used almost universally and incandescent lamps to so limited an extent?

I think there will be no discussion as to the reason. Incandescent lamps for street lighting have always been difficult to make and less satisfactory than any other type of incandescent lamp.

The ordinary 100-volt to 125-volt, sixteen candle-power, three light-watts per candle incandescent lamp gives more candle-hours for a given input than any other incandescent lamp. Could this lamp be used for street lighting the cost of street lighting by incandescent lamps could be materially reduced and the service rendered be much more satisfactory to the user of the highway.

There are many streets in which low voltage mains run the length of the streets and where these lamps could be used in multiple with no inconvenience. There are many other streets where ten or twenty could be used in series, each on a cut-out box, no more complicated than the Nernst lamp, which you will possibly be called upon to consider. These cutout boxes would not be so complicated as the arc lamps, which operate with practically no attention.

I do not understand why this has not been done.

Times have changed. The arc lamp lines are no longer the only wires on the poles. Probably one-half of the electric lighting poles carry alternating-current mains also.

Incandescent lamps are now universally fastened to their bases by a water-proof cement, and water-proof sockets are in stock everywhere.

Is it not time we broke away from tradition?

The arc lamp has its use in street lighting. There are places where it is wisest to use it. The public think they are getting more for their money with the brilliant arc lamp, but I believe as the users of the highways come to appreciate how much safer and more satisfactory well placed illumination is than that to which I have referred, that we shall learn to light our streets as we do our homes.

The lesson learned in show-window lighting and in theatre stage lighting should not be lost upon us.

It is not the light after all that interests us; it is what we see by means of the light.

We must add to this that for a given expenditure of energy more light can actually be delivered to a highway by incandescent lamps than by arc lamps, and it can be better distributed.

Arc lamps are at their best in densely settled districts. The reflected light from buildings helps to economize the distribution and the great quantity of light from store windows also assists to so brighten the surroundings that the brilliant arc lamp is less blinding. Arc lamps are also more closely spaced in these localities, which is to their advantage.

Incandescent lamps are, in my opinion, much to be preferred for residential streets, side streets and outside the more congested portions of a town or city.

Mr. Steinmetz, in commenting on Mr. Doane's paper, gave an amusing account of his attempts to light his new greenhouse with innumerable incandescent lamps and his substitution of one large arc lamp for them. He also spoke at some length of the effect of surroundings, such as buildings and trees, on street lighting distribution.

The next paper was that by Mr. John W. Howell, which follows:

THE INCANDESCENT LAMP OF TO-DAY.

BY JOHN W. HOWELL.

The incandescent lamp is too well known to you all to need an introduction or any description. It has been so often discussed before you that nothing remains to be said about it except as a part of the electric lighting system in the general discussion of the subject under consideration this evening.

The characteristic features of the incandescent lamp are its extreme simplicity, its absolute freedom from mechanism, the ease with which it can be lighted by means of a switch placed where most convenient and its adaptability to low candle units and decorative effects. These features and the fact that it consumes no oxygen, yields no gases and has no flame, have won for the lamp its great popularity.

The incandescent lamp is adaptable to any system of electrical distribution in use for any purpose. There appears to be no difference in its operation on direct or alternating current, provided the latter has a frequency of twenty-five cycles or more per second. It is usually operated on constant-voltage circuits, but gives even better results when operated at constant current, as the increase in resistance of the filament with use increases the watts consumed and thus causes the lamp to maintain approximately its initial candle-power throughout its life.

For street lighting, incandescent lamps are operated many in series on high voltage circuits of constant current. They are also made for burning directly in series with arc lamps.

The incandescent lamp is adaptable to those voltages which are generally considered safe for interior use. Two kinds of carbon are used in making filaments and the best results require the proper combination of the two kinds. The specific resistance of these two kinds of carbon limits the voltage of lamps of a given candle-power and efficiency in which this proper combination can be made.

Lamps for a higher voltage than will permit the proper combination of the two kinds of carbon may be made with less of the graphitic coating, which has a low specific resistance, or entirely of the base carbon, but in either case the lamp should be operated at lower temperature to give equally good life and candle-power results.

The best results are obtained with lamps of not higher than 120 volts; 250 volts being now regarded as the maximum desirable voltage, and at this point there is an increase of about one-half a watt per candle for equally good results.

The efficiency of an incandescent lamp depends upon the temperature of the filament—the higher the temperature the better the efficiency and the shorter the life. Lamp efficiencies are usually stated in watts consumed per horizontal candle. The commercial limits are between two and one-half and four watts per English candle, or about 120 per cent of these figures if spherical candle-power is considered, the two and one-half-watt lamps being used where electricity is expensive and regulation good, and the less efficient

lamps where electricity is less expensive or regulation is not so good, or where other considerations demand a longer useful service from the lamps.

The color of the light from an incandescent lamp depends entirely upon the temperature of the filament, the higher the temperature the more nearly white the light becomes. The color of the light generally is yellow. Weber observed that the first visible radiations from a filament as it was heated came not in the red region of the spectrum, but in the yellow region, where the maximum radiation occurs when the lamp is at high temperature.

Dr. Nichols observed that carbon has a selective radiation in the yellow region of the spectrum, the radiations there increasing faster than radiations in the other parts of the spectrum.

The use of higher efficiency lamps is becoming quite general, very few four watts per candle are now used for multiple lighting, while a few years ago no lamps of less than four watts per candle were sold. This is due to the improvement in quality of the lamps and also to better regulation of the current. High efficiency lamps are more satisfactory than low. The filament being smaller, the bulbs blacken less and being hotter they break before reaching very old age. Low-candle-power lamps are also coming into more general use. The demand for these has increased very considerably in the last two or three years. The use of lamps for decorative effects and for special work of various kinds has increased the usefulness of the lamp and added to its popularity.

Mr. Howell in closing his remarks stated that he did not believe selective radiation had anything to do with the efficiency of the Nernst lamp. He thought rather that this efficiency is due to the enormous temperature at which such lamps are worked and not to any peculiarity of the radiating substances.

Dr. C. H. Sharp then presented the two short papers which appear below:

A NOTE ON AN ACETYLENE-IN-OXYGEN FLAME.

BY CLAYTON H. SHARP.

In the conclusion of a report made to this institute in 1896 by a subcommittee on Standards of Light, of which Professor Nichols was chairman, it was stated that the subcommittee had in hand the investigation of a possible standard in which a pure gas, burning in a pure atmosphere, should furnish the constant flame required. Since these investigations, which are being carried on by myself, have now been at a standstill for some time, this note is presented with the hope that it may be of some interest.

The idea underlying the work was to produce a flame which should be isolated from fortuitous outside influences, such as atmospheric purity and moisture content, which have so large an influence on ordinary flames.

A long series of experiments was conducted on a flame produced by the combustion of a mixture of equal parts of acetylene and hydrogen in an atmosphere of oxygen. The special burner employed gave a flame long, slender and of great brilliancy and steadiness. It was found, however, that its intensity was not reproducible from pressure measurements made on the gases. This was attributed to the

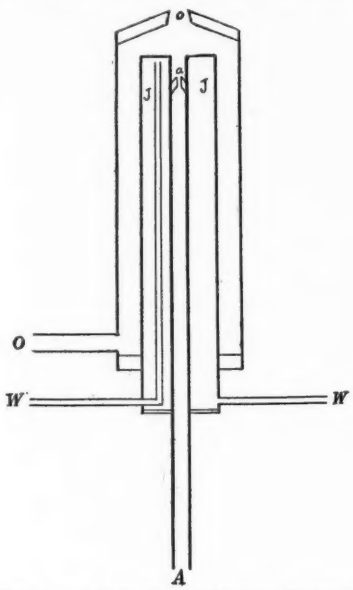


FIG. 1.—ACETYLENE-IN-OXYGEN BURNER.

fact that the acetylene-hydrogen mixture was stored over water. Since the solubility of these gases in water is not equal, and their temperature coefficients of solubility are not the same, the relative proportions of the two gases in a mixture so stored would not remain constant. Thus the first requisite of a standard of light—namely, a fuel of perfectly definite composition—was lacking.

The reason for adopting the acetylene-hydrogen mixture instead of pure acetylene as a combustible had been that, with

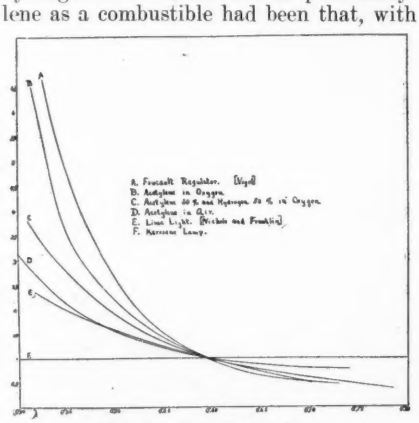

A. Foucault Regulator. (Rigid)
B. Acetylene in Oxygen.
C. Acetylene 50 % and Hydrogen 50 % in Oxygen.
D. Acetylene in Air.
E. Lime Light. (Bricks and Fronkling)
F. Kerosene Lamp.

FIG. 2.—LIGHT CURVES.

the burner employed, pure acetylene deposited graphitic carbon about the jet with such rapidity that the flow of gas was seriously obstructed after only a moment's burning. With the diluted gas this did not take place. After the failure of the mixture to yield the constant flame required, experiments were made to determine what form of burner would permit the pure acetylene to be used. This was found to be as shown in Fig. 1.

The acetylene passes through the tube, A, which is surrounded by the water-jacket, J, in which a circulation of water is maintained to keep the acetylene tube cool, and issues at A. The oxygen enters at O, a concentric tube, and issues through O in a stream about the stream of acetylene. The water-jacket is carried above the acetylene jet so that a mixture of the two gases and, consequently, combustion, takes place only after the acetylene is well away from the jet from which it issues. With this arrangement there is no troublesome deposit of carbon and the experiment can be carried on indefinitely.

The flame so produced is capable of enormous variations according to the relative supplies of the gases. When the oxygen is not turned on at all, the flame is tall, unstable, murky and smoky. With increasing supply of oxygen, the flame shortens and increases in whiteness, brilliancy and luminous intensity. It also becomes stable and is little affected by drafts. If the increase in oxygen supply is carried beyond a certain point, the luminous intensity begins to fall off, due to the non-luminous combustion of a larger proportion of the acetylene, until with a large excess of oxygen the flame becomes almost entirely blue.

Barring practical difficulties, the intensity of this flame should be definable as follows: With a given rate of flow of the gases, the height of the flame should be a given one and the luminous intensity of the flame as a whole should be a maximum, and the luminous intensity of a portion of the flame isolated from the rest by a horizontal slit of a given width in a screen placed in front of the flame in such a way that the amount of light passing through the slit should be a maximum, would then be perfectly fixed. The criteria mentioned are not all independent ones, but serve as checks on each other and increase the certainty with which the flame can be reproduced.

In my experiments I measured the height of the flame by projecting an image of it on a graduated screen. To measure the flow of the gases a diaphragm with a very small opening was interposed in each feed pipe and the gas pressure behind was determined by inclined tube manometers filled with alcohol. This method was not found to be sufficiently sensitive and reliable. It would probably be far better to fix the relative pressures of the gases by passing them through small gasometers the bells of which are fixed to opposite arms of a balance, as Petavel* has done in his experiments with the Violle platinum standard, and then to determine with only a moderate degree of accuracy the absolute pressure of one of the gases. The gas supply was regulated by micrometer cocks. The temperature of the diaphragms should be controlled and the gases should be dried.

The flame so produced is the most brilliant gas flame known. The results of spectrophotometric measurements on it

*Proc. Roy. Soc., vol. lxv, p. 481, 1900.

are shown in Fig. 2 in comparison with those made on other sources of light. Its color adapts it admirably for use as a secondary standard in arc light photometry, but it is too white for the incandescent lamp, just as the candle and the Hefner lamp are too red. This fault is at least in the right direction, since it is desirable that the color of the primary standard of light should approximate to the color of the average source of light in practical use, and the constant tendency of this color average is toward the white.

THE PRESENT STATUS OF THE QUESTION OF A STANDARD OF LIGHT.

BY CLAYTON H. SHARP.

The situation as regards a standard of luminous intensity has shown in recent years a marked tendency toward simplification and unification. A number of standards or would-be standards, which were formerly taken seriously, have disappeared from practical use. Of the various candles, the British candle is the only one which survives, and the practical use of it is steadily decreasing. The Carcel lamp is held in much less esteem than formerly. Practice is settling down to the selection of one of two classes of standard, either the pentane standard in one of its forms, or the Hefner amyl-acetate lamp.

The small one candle-power and one and one-half candle-power pentane lamp has proven itself worthy of confidence as a result of thorough investigation in the Reichsanstalt. The ten-candle-power pentane lamp is coming into very extensive use by the gas men here and in England, and commends itself by its simplicity of operation, by its relatively high intensity and, as far as is known, by the constancy of its indications. Unfortunately there is on record no such careful investigation of its properties in this particular as has been made for the smaller pentane lamp and the Hefner lamp.

If gas practice is looking more and more to the pentane standard, electrical practice is looking toward the Hefner lamp. The careful study made in the Reichsanstalt, the adoption of it officially in Germany, the resolutions in its favor by this Institute and by the Geneva Congress of 1898 have served to popularize it and to intrench it strongly.

While the facts enumerated show that great progress, it is not to be assumed that a satisfactory solution of the problem of a standard has been reached. A standard must be as nearly as possible a common denominator of the sources of light in ordinary use. No one integrated source of light can be in all strictness a common denominator for all, on account of the existing differences in quality or color. That light most nearly fulfills this condition which most nearly approaches in color the average color tone of the sources of light in use to-day. Now this is much higher than it was a few years ago, due to the extensive introduction of whiter hued sources of light. The standards referred to above stand, as far as color is concerned, about at the bottom of the list, and from this point of view is as bad as possible. Photometric comparisons with them of most modern lights are very uncertain and the results are misleading in that they do not give to the whiter sources credit for the greater visual acuity per candle-power which is their due.

It follows that a standard of light of considerably whiter hue than the present one would be intrinsically better if of equally good qualities in other respects, and it is toward the definition of such a standard that efforts should be directed.

Quite a good deal has already been done in this line. A notable advance has been made by Petavel* in his investigation of the Violle platinum unit. He has indicated the precautions which must be taken to secure good results, and has demonstrated that the limits of error may be made quite narrow. The color of this standard is quite good. Violle has stated that it is very similar to that of the acetylene flame, but this statement does not seem to be entirely consistent with the known fact that platinum can readily be fused in the acetylene flame.

The studies by Paschen and by Lummer of the theoretically "black" body have indicated a method by which a perfectly definite radiating surface can be secured, and it needs only a sufficiently accurate method of defining the temperature of such a surface to give us a standard of light. Since, however, the luminous radiation from such a surface increases as a high power of the temperature, a sufficiently accurate method of temperature definition can not easily be found.

Among the ordinary sources of light, the acetylene flame probably approaches most nearly in color to the average hue. The ease with which this gas can be produced in a good degree of purity and the steadiness and manageability of its flame also commend it for use as a standard. Violle,† Fessenden‡ and Féry§ have made independent propositions to this end, but no definite standard has yet been the outcome.

Fessenden showed how a stable flame can be produced with this gas employing the method of the converging jets now in common use. He found the flame to be very steady and moderately immune from outside influences. Such a flat flame, with the light from its edges screened off, has been used very successfully by Professor Nichols** in his spectro-photometric investigations of the radiation of carbon. The flame as controlled by measurements of the pressure of the gas.

The proposition of Féry looked to the use of a long, slender flame. He used a bit of thermometer tubing of internal diameter of 0.5 mm. as a jet. With this he found that the luminous intensity of the flame was proportional to the flame height between the limits of 1 cm. and 2.5 cm., that is, he substituted for control by pressure measurements, control by measurement of the flame height.

What is now known of the properties of the acetylene flame indicates that a search for the best method of producing and defining an invariable acetylene flame would be fruitful of valuable results.

It has been proposed to employ as a standard flame one in which a pure gas burns under standard conditions in a pure atmosphere, both of known chemical composition. A practical method of burning pure acetylene in an atmosphere of pure oxygen has been found, as well as direct and interchecking methods for the control of such a flame, but the investigation has not led to any definite result.

Until a more satisfactory standard is introduced, photometrists are practically limited to the choice of either a pentane standard or the Hefner lamp as primary standards. An incandescent lamp carefully seasoned and measured furnishes for most purposes a thoroughly satisfactory secondary standard, and we are looking forward to the time when the National Standardizing Bureau will establish an authoritative standard and will measure and will certify to lamps sent to them for this purpose.

Mr. Peter Cooper-Hewitt then read his paper, which appears here in abstract, and exhibited his mercury vapor lamps.

ELECTRIC GAS LAMPS AND GAS ELECTRICAL RESISTANCE PHENOMENA.

BY PETER COOPER-HEWITT.

On a former occasion I had the honor of showing to the members of the Institute lamps utilizing the conductivity of gas for illuminating purposes, including experiments illustrating certain laws of conductivity of gases, and I also presented curves directing attention to various characteristics. It gives me pleasure to-night, while showing lamps in operation lighting this room, to describe some of the phenomena exhibited by the lamp and to indicate some of the difficulties encountered in determining the relative values of the resistances therein.

The mercury gas lamps exhibited to-night are operated on the standard Edison 118-volt direct-current circuit installed in this building; lamps of this class consume amounts of current varying from one to six amperes, and the efficiency is approximately one-half watt per spherical candle-power. Under better conditions as high an efficiency as one-quarter watt per spherical candle-power has been obtained, determined by careful and accurate measurements. Measurements were made by measuring sections of the lamp varying in length from one-quarter of an inch to three inches, shielding the lamp and leaving a slot in the shield of the length mentioned and measuring the light transmitted through the slot. These measurements have been made with lamps of various diameters. Dr. Max von Recklinghausen has made independent measurements, comparing the illuminating value of the lamps with incandescent lamps of equivalent rated candle-power, and the results of such tests agreed remarkably well with the measurements obtained upon photometers.

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* Proc. Roy. Soc., vol. lxv. p. 481, 1900.
† *Comptes Rendus*, vol. cxxii, p. 79, 1896.
‡ Trans., A. I. E. E., vol. xii, p. 500, 1895.
§ *Comptes Rendus*, vol. cxxvi, p. 1192, 1898.
** *Physical Review*, August and October, 1901.

The light produced by pure mercury gas comprises orange-yellow, lemon-yellow, green, blue, blue-violet and violet; and although all shades of these colors may not be present, their absence would not be so seriously felt were it not for the absence of the red. For some purposes the lack of red in the spectrum is objectionable, but for many uses it is a positive advantage.

For shop work, draughting, reading and other work where the eye is called upon for continued strain, the absence of red is an advantage, for I have found light without the red is much less tiring to the eye than with it. It is possible to transform some waves of this light, especially the yellow light, into red light, and thus in a measure to overcome this defect where required for indoor illumination. A moderate amount of ordinary incandescent light interspersed with the mercury gas electric light serves to supply the deficiency, and the mixture may be made most satisfactory. For ordinary street lighting purposes the mercury light is available even without the red, and it should be noticed that this light has very great penetrating power and seems to be effective through greater distances than an equivalent amount of measured candle-power from the ordinary incandescent lamp. This may be due to the fact that the waves of the red light are less penetrating than those waves which are present in the mercury light, and hence the least valuable portion of the spectrum having such illuminating effects is omitted and the energy is practically expended in the more useful portions of the spectrum.

I would like to state some of the phenomena that had to be unraveled before it was possible to establish the laws governing the operation of electric gas lamps. The conductivity of the gas of the lamp, which is the most important factor, is dependent upon the diameter of the gas column, the length of the gas column, the density of the gas in the column and the resistance factor of the particular gas; with these must be considered the resistance at and about the respective electrodes to obtain the total resistance presented by the lamp. In determining the relative values of these it was assumed that the resistance of the gas column would vary directly as the length; this has so far proved to be true. From the results of a great number of experiments, and from some particular ones, I was able to demonstrate that the resistance varied inversely with the diameter; not as a square, as in metallic conductors, but very nearly as the first power. It is very difficult to obtain identical surroundings for lamps of different diameters, and I am of the opinion that any discrepancy that occurs is due to difference of environment. I was able to demonstrate that the resistance varies inversely with the quantity of the current passed, which means that the lamp requires a constant voltage unless some change takes place. The voltage across the terminals of the lamp is modified by the density of the gas, a gas having a density of maximum conductivity or a certain definite amount of matter and molecular movement best suited for conduction. Beyond the point of maximum conductivity the resistance appears to increase absolutely directly with the density, but I wish to state that my means of measuring at these low densities were not sufficiently accurate. The density is an entirely controllable factor, and is one of the best means of controlling the voltage. The laws above stated appear to hold good as to gases, generally.

The electrode resistance at the positive, providing there is no alteration of the chemical or physical condition of the electrodes, may, from a practical standpoint, be regarded as being very slight and will be neglected for the present.

The negative electrode resistance offered very great difficulties and required long and patient experimental investigation. I found that it consisted of a variety of factors, and I will briefly direct attention to those which appear to have the more important bearing upon the operation of the lamp. There is a reluctance to the initial passage of current which appears as if self-created by the current—as if by induction. Upon increasing the voltage applied thereto, current passes to a very small extent and thereupon there is a fall in resistance. To increase this small amount of current the voltage must be still further increased. On further increase of current this resistance apparently ceases and there is an enormous decrease of voltage. This resistance apparently does not exist when chemical or physical alteration occurs at the electrodes.

When the last named resistance is overcome by reason of passing current, a flame may be noticed proceeding from the negative electrode in a direction perpendicular to the surface from which it issues. If this flame meets the current in a right line, that is to say, projects in the direction of the flow of the current at the point of meeting, the total resistance of the lamp is materially greater than when the flame proceeds in a direction at an angle to the flow of the current.

When the flame is proceeding from the negative electrode at an angle to the line of the current, then the resistance at the negative electrode, under the conditions which are established, is reduced, and practically speaking, the principal and controlling resistance of the lamp is then located in the gas-path proper.

The reluctance to starting is greatly modified by charging the surface of the lamp exterior to the negative electrode positively, and also in a less degree by dissipating the charge that collects there. It is for this reason that the lamps have a conducting band exterior to the negative. This resistance may also be modified by charging and discharging the lamp with a high-voltage current.

I may here add that these initial resistances to the passage of current may be overcome by an impulse of high potential, as by the discharge of a reactive coil.

In some particular forms of lamp the resistance at the negative electrodes has been availed of to render the negative electrode, itself a source of light. Such conditions were established that no physical or chemical change took place at the negative electrode, and it developed that the electrode could then be heated to any desired temperature. Iron electrodes under these conditions may be maintained at a very high temperature and give off considerable light, the electrode itself being then the chief source of light. I even succeeded in melting platinum and maintained it in a molten puddle.

Referring again to the flame occurring at the negative which is present while the lamp is in operation, it may be stated that the direction of the flame is largely, if not entirely, independent of the direction of the current, and is determined by the plane of the surface receiving the current. The direction of the flow of the current to that surface is, generally speaking, through the shortest path from the positive electrode, so that if the entrance plane of the negative electrode surface be out of the perpendicular to the flow of the current, then the flame may be made to proceed in a direction out of the path of the current and thus will not interpose its resistance to the current flow. In some of the types of lamps shown here tonight, the surface of the mercury constituting the negative electrode, as will be seen, does occupy such a position with relation to the path of the current, and the flame proceeds in a line out of the path of the current. In some of the lamps, for the purpose of causing the position at which the current passes into the negative electrode to remain fixed and the flame regulated, the metal leading-in-wire is carried to a point at the surface of the mercury, and the path of the current once being fixed upon this point remains there instead of wandering about the surface of the mercury, the current entering the meniscus. The flame may be deflected and its position controlled by the use of a magnet when so desired. Where no point is used there is a tendency for the current to wander and burrow, as it were, into the body of mercury. This results in temporary depressions, so that the flame may proceed from the walls of these depressions in a direction at an angle to the direction taken by the current, but the wandering of the current about the surface of the mercury will necessarily cause a constant shifting of the direction of the flame and cause variation in the resistance of the lamp.

I have used other gases than the vapor of mercury as the gas-path, but mercury is more convenient for general experimental investigation for many reasons, among them the fact that as a negative electrode, its resistance is stable, the readiness with which the alteration of its condition may be brought about, the high efficiency of a mercury gas as a light-giving medium, and also the fact that it can easily be obtained in a fairly pure state.

Mr. W. J. Hammer exhibited some calcium tungstate tubes which Mr. T. A. Edison had used in early experiments on

electroluminescence and also showed several recent European forms of Nernst lamps, and exhibited a small tube of a highly active radium compound.

DISCUSSION.

The discussion was opened by Mr. John W. Lieb, Jr., who related an account of a re-comparison of some present American secondary standards lately made at the Reichsanstalt, which exhibited an accordance within two per cent of the results obtained from similar standardizations more than ten years ago. This was an interesting and satisfactory demonstration that the variation of American standards during that period had been only to this insignificant degree.

Mr. J. B. Fleming stated that the color of enclosed arc lamps was good if the voltage was kept within reasonable limits, and that opal glass globes had been found very satisfactory in correcting the tendency of such lights to blueness. Dr. Bell replying, stated that the alternating arc was much less efficient than the direct-current open arc, and that in his previous remarks he had meant only to state that the seven and one-half ampere enclosed arc is equal in street illuminating efficiency to the ten-ampere open arc.

Dr. C. A. Doremus related an interesting bit of history concerning oxygen gas distribution for use with street lamps of the Drummond type which was in vogue in New York many years ago. Mr. Doane called attention to certain errors of the Bunsen photometer. Mr. George T. Hanchett gave an interesting account of a method of distributing light which he had noticed in a spining-mill in New England. In this mill open arc lamps were used burning upside down, that is, with the positive carbons below, and these were enclosed in conical reflectors which directed their light against a white ceiling. The arcs were nowhere visible from the floor, but the general illumination attained was very satisfactory. Dr. Bell said that in attempting to diffuse the illumination one must not go too far and entirely eliminate shadows, as shadows were useful in handicrafts of various kinds, and were used as an unconscious criterion of judgment. President Steinmetz related at some length the experience of European engineers in the use of inverted open arcs and shades. Dr. Bell spoke of selective radiation and the fact that it is confined to a few substances belonging to two groups of rare elements. Mr. J. W. Howell closed the discussion by reference to the new titanium carbide incandescent lamp upon which he thought he would be able to report more at length later.

The meeting adjourned at eleven o'clock.

THE CONSTRUCTION OF SMALL TELEPHONE EXCHANGES—XXII.

BY A. E. DOBBS.

Fig. 93 shows another plan sometimes used, and even recommended in some written articles, but it is here shown for the purpose of calling attention to its weakness, although it has many good points.

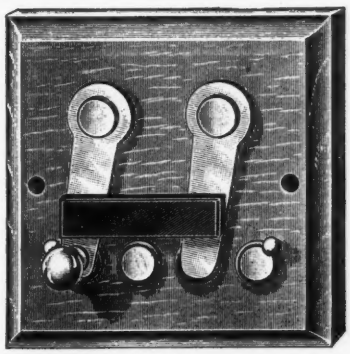


FIG. 92A.—CIRCUIT-CHANGING SWITCH.

In this figure both lines are looped into the station switchboard, where they are connected to two double-contact jacks in series with each of them. The line signals are recorded on an extension bell placed in the circuit between the two jacks. Between the two double-contact jacks there may also be placed an open jack into which the plug can be inserted, if desired to keep the line closed. Of course, the house telephone is connected to the line by means of the plug, and in this way can be useful in taking care of

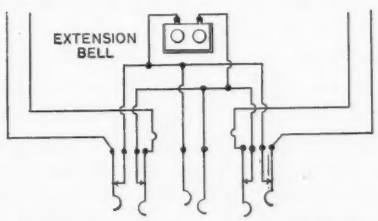


FIG. 93.—TEST OR DIVIDED LINE STATION.

The extension bell receives all the signals, the telepl one being connected by means of a cord and plug.

any branch lines that may come into the station.

Now for the advantage of a switch of this kind: Should the attendant wish to use the east end of the line, he plugs in on the east side, leaving the west side free for some one else, for the plug opens the line at that station. In plugging the east side his own station instrument is used as a "ring off," leaving the extension bell on the other end of the line. This plan divides the line into sections, and sometimes expedites business by allowing two or more parties to use the line at once.

If, however, the attendant neglects to take down his plugs as soon as he gets a "ring off" he may delay through messages, which is a disadvantage.

There is another convenience in this method in that it makes testing easy, or allows the use of one end of the line in case of trouble.

It, however, has the disadvantage of having four movable contacts at each station, which may be the means of opening the line at the points of contact, a grain of dust being sufficient for this purpose.

A modification of this plan is to be seen in Fig. 94, in which the jacks are wired in the same manner but bridged by the switches, which can be opened for testing purpose, or at any other time it may be desirable to divide the line. With the switch closed, the insertion of a plug merely cuts the extension bell out of that particular side of the line, leaving it as a signal for the other end. With the switch open the line still remains closed through the jacks as in Fig. 93, the connections being then precisely the same, the line being divided by the insertion of a plug.

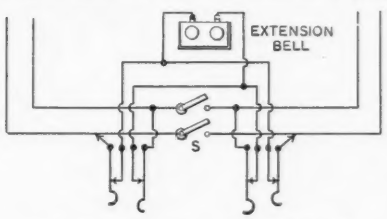


FIG. 94.—IMPROVEMENT ON FIG. 93.

Fig. 95 is simply Fig. 94 applied to a grounded line, the difference being that single instead of double-pole jacks are used.

SELECTIVE RINGING.

In order to obtain selective ringing of the subscribers' bells it is necessary that the ringing current should differ from that ordinarily employed.

The ordinary magneto generator is a very simple piece of apparatus and consists of a single coil wound in the armature, one end of which is connected to the shaft, and therefore to the generator frame, and the other to an insulated tip at the end of the shaft. This armature is suspended between the poles of several electromagnets. When the armature turns over the lines of force passing through it

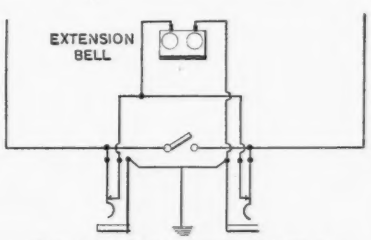


FIG. 95.—FOR GROUNDED LINES.

are disturbed which creates an electric impulse and when connected in this manner the current in the line is reversed every time the armature turns over, thus making two reversals at every revolution which ring the bells by reversing the current in their magnets, drawing the clapper first to one side and then the other.

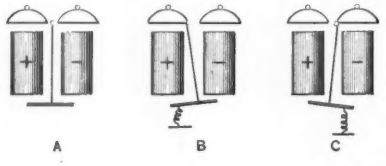


FIG. 96.—POLARIZED BELLS FOR SELECTIVE SIGNALING.

Before going farther, let us stop and consider Fig. 96, which illustrates the matter more fully.

First, let us consider the bell, A, which is arranged for alternating currents. When a current passes through these coils let us suppose that they are so wound that a current passing from left to right draws the armature toward the left side, and that a reverse current draws it to the right. In this case an alternating current, as from an ordinary generator, draws it alternately first to one side and then to the other, which, it may be, will be at the rate of from ten to twenty alternations per second.

Fig. 96, B, shows us the same kind of a bell magnet with this difference, that the bell armature is held toward the + magnet side by a spring. Should a current be sent to line in this direction which, for the sake of simplicity, we will call a + or positive current, it will have no effect on the bell, because the armature already has a set to that side. Should a — or negative current be sent over to the line, the effect will be to pull it over to the — or negative side, but it will immediately be pulled back by the spring when this impulse ceases, so that with one impulse we get two strokes of the clapper just the same. Therefore, if we send impulses over the line of a — character, only the bells on the line connected as at B will ring.

Fig. 96, C, however, is held to the opposite side of the magnet, and as these bells are held on the — side they will only respond to + impulses. Now, by arranging our generator in such a manner that by pressing one button only + impulses are sent to line, while by pushing another will send — impulses to line, we can ring either one of these bells without disturbing the other (see Fig. 97).

Fig. 98 shows how this idea can be carried still further. In this case we have a metallic circuit line divided into two parts, each separate from the other so far as signaling is concerned, the bells on each side being connected to ground through high-resistance ringer coils.

The line at the board is so arranged that the current can be manipulated at the will of the operator, either by being divided between four different jacks, or it may be brought into one jack and the ringing current manipulated by four different push-buttons so as to send + or — impulses over the "tip" side or + or — impulses over the "sleeve" side. Telephones A and C are thus on the X wire, while B and D are on the Y leg.

From preceding explanations it will now be clear that A and C can be signaled from one side without interference with each other, while B and D can likewise be signaled. Thus we have four telephones, any one of which can be called without disturbing any of the others.

Fig. 99 shows the same idea applied in a somewhat different way, the stations A, B being signaled through the two sides of

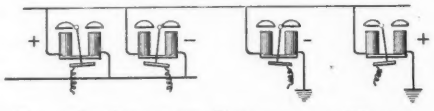


FIG. 97.—SELECTIVE RINGING FOR METALLIC CIRCUIT OR GROUNDED LINE.

the metallic circuit, while C and D are connected to the ground.

In both systems the instrument wiring is so arranged that when the hook comes up there is a metallic circuit connection to the exchange.

Of the two plans, the one shown in Fig. 98 is probably the better, as being more simple and better balanced. With high-resistance ringers there is no serious disturbance arising from their being grounded, unless the line should be a very long one. It might be added that signaling by means of alternating currents can be divided by the plan shown in Fig. 98, to the extent of reducing the number of signals, as in that way only half the bells would ring at one time.

In Fig. 99 it would not do to put one of the bells, C, D, on each leg of the line, as might be supposed, because the current crossing over the ringers at A, B would produce interference of signals.

Now a word as to the generators.

In Fig. 100 is shown the armature coil of a generator as a single loop, for the sake of simplicity.

The inside end of the armature coil is generally connected to the shaft, S, while the other side is connected to an insulated pin, P, and the current taken off by the contact spring, C. The current through the spring, C, is first + and then — at each revolution of the armature.

Now, suppose instead of the pin, P, and spring, C, we replace them with a wheel, W (Fig. 101), the wheel being so arranged that the contact spring or brush, C, is resting on the wheel for only half a revolution, leaving an open circuit during the other half. If we then suppose that the wheel is set on the + side of the armature only + impulses would, therefore, be sent to line, which would ring the bells adjusted for + signals.

Should this wheel be turned so that it would make contact at the other side of the armature, then — signals would go to line. Should there be two wheels placed on the same shaft and insulated from each other, but so set that one brush would be on the + and the other on the — side, it would then become possible to send either a + or — signal to line at will by connecting the lead wires to proper keys.

In Fig. 103 is shown some forms of wheels used in generators of this kind. A is a half wheel which, as will be seen, makes contact for only half of its revolution. B is a round wheel, but instead of being placed on the shaft at its centre it is set to one side, and in this way is also out of contact with the brush half the time. This form would make a smoother contact with the brush than the half wheel, A. C is a solid wheel set on its centre, but the brush for half of its revolution rests on insulating material, I. This form of wheel has the advantage that the brush runs smoothly and free from vibration, though it is more troublesome to make than either of the other two.

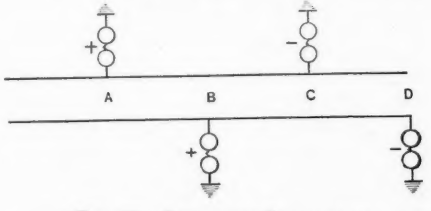


FIG. 98.—SELECTIVE SIGNALING.

Lastly, by disconnecting the wire from the shaft and connecting it to a commutator, as shown at D, we obtain a continuous direct current.

It will be seen from a study of these sketches that it is possible to get several different forms of current from one machine, all of which may be used in a modern exchange.

First—We have the alternating current of the magneto generator.

Second—By putting on commutator rings we can obtain positive and negative pulsating currents for selective ringing.

Third—By the use of a commutator we can obtain a direct or continuous current for supervisory or other signaling, which, by proper circuit changing devices, may be either + or —, or both combined.

As said before, all of these combinations can be and are often made in one machine.

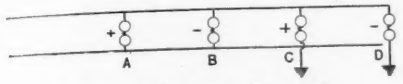


FIG. 99.—SELECTIVE SIGNALING.

For an exchange of from 500 to 1,000 subscribers, the generator should deliver about one ampere of current at 95 to 100 volts when required, which would ring about fifty telephones at one time, if necessary, although it would probably not be called upon very often to take such a load as this, but as a short-circuit on the line takes rather more current, it is well to have plenty to fall back on.

A generator of this size, at sixty per cent efficiency, will require nearly a quarter of a horse-power to drive it at full load.

Telephone Development on the Pacific Coast.

From a report sent out of the telephone business on the Pacific coast some statistics are secured relating to the remarkable telephone development in that section of the country. It is believed that the telephone industry has reached the highest percentage of development at that point in proportion to population of any district in the world.

The list presented below of cities and towns in the territory of the Pacific States Telephone and Telegraph Company, of which Mr. John I. Sabin is president, gives the average percentage of telephones to population and will prove of much interest to the telephone fraternity:

Exchange.	Population.	Subscribers.	Per-centage.
San Francisco	342,782	29,101	8.49
Los Angeles	102,479	10,841	10.58
Oakland	96,638	7,899	8.17
Portland	90,426	8,287	9.16
Tacoma	37,714	3,392	8.99
Spokane	36,848	4,510	12.24
Sacramento	29,282	2,447	8.36
San Jose	25,150	3,326	13.22
San Diego	18,786	1,504	8.01
Stockton	17,506	1,714	9.79
Fresno	12,470	1,692	13.57
Walla Walla	10,049	817	8.13
Pasadena	9,117	756	8.29
Eureka	7,327	740	10.10
Phœnix	5,544	524	9.45
Bakersfield	4,836	1,005	20.78
Napa	4,395	374	8.51
Salem	4,258	578	13.57
San Rafael	3,879	331	8.53
Marysville	3,497	355	10.15
Hanford	2,929	320	10.93
Chico	2,640	312	11.82

The *Aluminum World* says that the best lubricant to use on aluminum when turning it in a lathe is either petroleum or water, and in the press, when it is being drawn or stamped, vaseline.

Another Rubber Substitute.

In the Rocky Mountain "greasewood plant" a substitute for rubber is said to have been discovered. The young shoot of the plant has a milky sap and the old wood a resinous gum; the former is bruised between rollers so that the bark is loosened, and the older wood is crushed. The entire mass is then enclosed in a

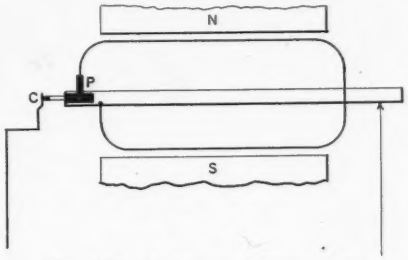


FIG. 100.—ORDINARY ALTERNATING GENERATOR.

vessel, mechanically agitated, and exposed to the action of carbon-bisulphide, carbon-disulphide, naphtha, or other solvent of india-rubber. After exposure for some hours to the action of the solvent, heat being applied if necessary, the liquid is strained off. The liquid solvent and contained gum are then placed in a closed vessel, and the volatile solvent driven off by heat. The gummy mass that will not

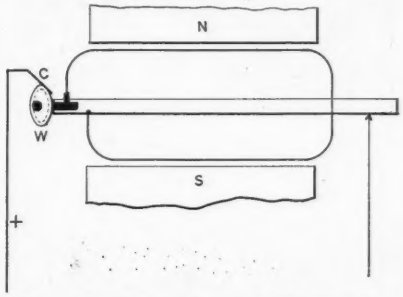


FIG. 101.—SINGLE IMPULSE GENERATOR.

volatilize in the still or receiver is then washed in water, either warm or hot, and is then subjected to repeated rollings. The gum resulting is of a brown color, highly flexible and elastic, combustible, and possesses the characteristic of india-rubber, except that it has rather a balsamic odor, differing from the odor of commercial rubber. The gum can be vulcanized by the addition of a quantity of sulphur in the same manner as the india-rubber of commerce.

Electric pickling of iron, according to a recent British patent, is accomplished by using an electrolyte consisting of acid and alkaline, or alkaline-earthy, salts. An example of such an electrolyte consists of 1,000 pounds of common water, 100 pounds of hydrochloric acid, five pounds of sulphuric, five pounds of hydrofluoric and fifteen pounds of caustic soda or potash. A bath lined with lead is used, and the iron or steel to be cleaned forms the cathode, the anode consisting of platinum lead or carbon.

The Official Opening of the Manhattan Railway Company's Electrical Service.

On the afternoon of Thursday, January 9, 1902, the first electrically equipped train on the Manhattan Railway Company, of New York city, was officially run. The train left South Ferry at two o'clock and made a run to 129th street, stopping at only a few of the intervening stations on the Second avenue line of the elevated system. The train consisted of six cars specially built for this service and made the trip with ease and in record-breaking time. The speed was estimated on the long runs to be at the rate of fifty miles an hour.

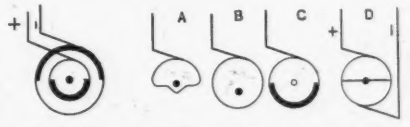
At the 129th street station the party inspected a new open car which it is planned to adopt for summer service. This it is thought will prove a popular feature, made possible for the first time by electric traction.

On the return the entire party visited the magnificent power-house at Seventy-fifth street and the East River, going over from the elevated station in the Fifth avenue electric stages of the New York Electric Vehicle Transportation Company.

There was a large number of prominent New York citizens present. The Manhattan Railway Company was represented by a large official staff, including Vice-President and General Manager Alfred Skitt, Electrical Director L. B. Stillwell and Superintendent W. E. Baker. The Metropolitan Street Railway Company was represented by President H. H. Vreeland and General Solicitor H. A. Robinson and others. The Rapid Transit Subway Company was represented by the contractor, Mr. John B. McDonald, and General Manager E. P. Bryan and Secretary Frederick Evans. Capitalists, railroad men and press representatives constituted quite a gathering, comfortably filling the entire train. The verdict was unanimously in favor of the improved service.

Cable from Natal to Australia.

Consul-General Bray reports from Melbourne that the Eastern Extension, Australasia & China Telegraph Company, Limited, has notified the government of



FIGS. 102 AND 103.—TYPES OF PULSATING CURRENT COMMUTATORS.

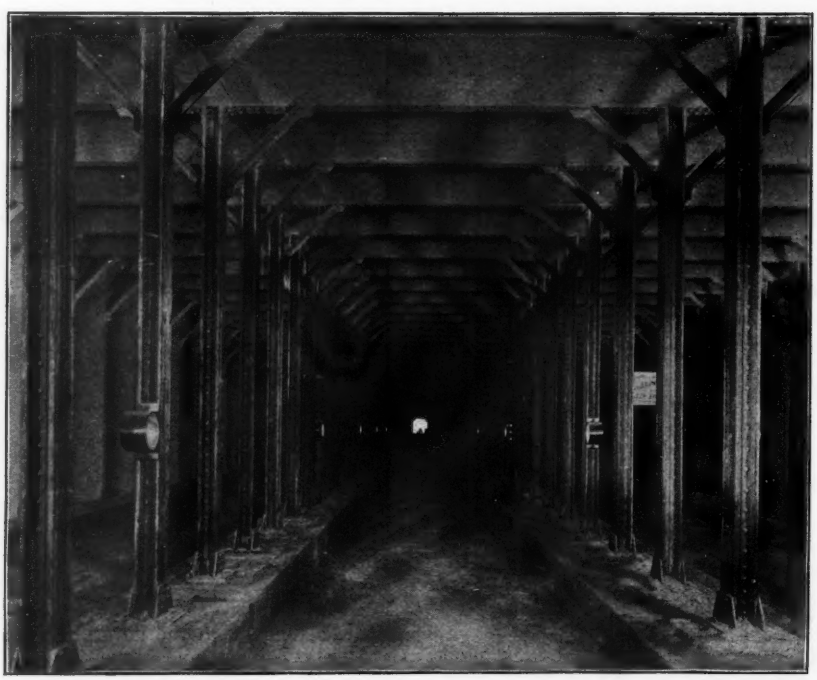
the state of Victoria that the Cape cable, from Durban (Natal) to Freemantle (Western Australia), is now ready for use, and congratulatory messages have been exchanged with the governments of Cape Colony, Natal and Mauritius. The section of the cable between Freemantle and Adelaide, South Australia, is now in course of construction.

Progress of Work on the Rapid Transit Subway in New York City.

IF the out-of-town reader is not better informed (and it seems most natural to assume that such is the case) than the average New Yorker as to what the Rapid Transit Subway really is, the popular conception is evidently of very scanty extent compared with the immensity of the undertaking. It is not, indeed, possible to compass, in a single article, any extensive delineation of what has been done, what is doing and what is planned for future progress on this tremendous work.

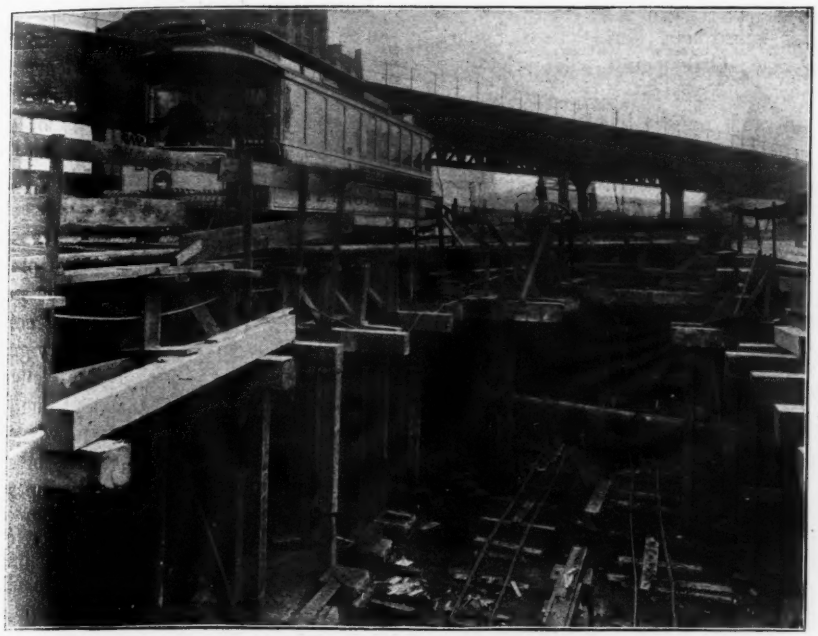
In discussing the subject with those directly connected with this enterprise, the comprehensive system of executive control at all points is everywhere self-evident. In laying out the original detail, city maps and records of every description had to be studied and the underground work of the big city carefully taken into consideration. The general plan has been to divide the work into four divisions, each in charge of a division engineer; these divisions are subdivided into sections in charge of section engineers, under whom is a corps of assistants and minor helpers. In the division engineer's offices are kept the detail and contract plans of the work. Each week an inventory of the work is plotted in colors, and obstructions and necessary changes are carefully noted on these maps. Every month the contract maps are carefully examined, lists compiled and part payments made to the contractors on the work. A system of horizontal markings recording in the progression in feet of each division is also recorded in these division offices.

CITY HALL LOOP (DOWNTOWN), SHOWING FINISHED CONCRETE ARC.



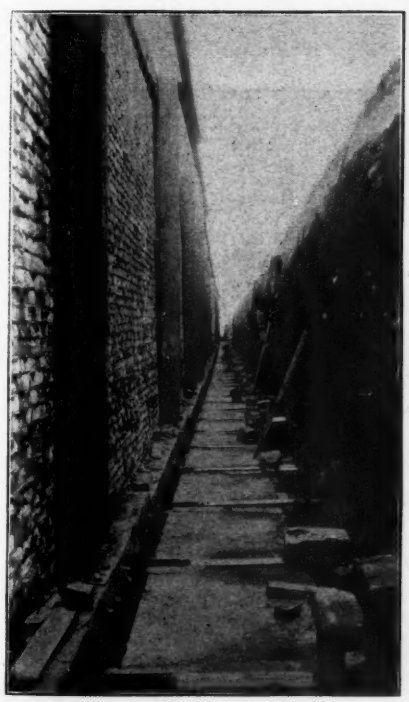
ELM STREET (DOWNTOWN) FROM BLEECKER STREET, SHOWING COMPLETED SECTION THREE BLOCKS IN LENGTH.

The third and fourth divisions, which have been consolidated, embrace the greatest extent of the work, taking in everything from the Boulevard and One Hundred and Third street, east and west, to the ends of the route in the Bronx and Kingsbridge. In this division is now under way probably the most interesting and certainly the most typical tunnel and subway construction. On the eastern projection, at One Hundred and Tenth street and Lenox avenue, the tunnel is being blasted through solid rock. Already the tracks, over which are transported the gondolas bearing out the loosened portions of stone, have pierced the rock some eight hundred feet. This lofty chamber, with its strings of glowing incandescent lamps,



65TH STREET AND BROADWAY, SHOWING EXCAVATION MADE UNDER TRACKS AND SUPERSTRUCTURE WHICH CARRIES METROPOLITAN STREET RAILWAY ELECTRIC CONDUITS.

the spectral donkeys and the muffled picking of the laborers far into the heading, conjure up some legendary cavern. But the picturesque features rapidly disappear as the work nears completion. A concrete arch is being formed as the rock is removed. Iron girders rise to a height of some twenty feet, and the wooden false-work centres are arched across. Over these centres the concrete is slushed and rammed, having an average thickness in settling of about two feet.



135TH STREET AND BROADWAY, SHOWING GREAT BRICK WALL READY TO BE MOVED.

From this point the tunnel takes an easy westerly curve to meet another boring, and northerly up Lenox avenue to One Hundred and Forty-third street, where it will turn under the Harlem River. Through Lenox avenue the construction is in a very advanced state, a greater part of the upper road-bed having been completely restored. At the river site, however, one of the most interesting features of the work will be undertaken, and a new and novel idea in under-water boring will be projected.

LENOX AVENUE AND 110TH STREET (CENTRAL PARK), SHOWING WOODEN CENTRES AND COMPLETED SECTION.

At One Hundred and Fourth street and Central Park West a shaft has been sunk, and the descent to the working is made in a typical mining cage. From this point drifts east and west extend for 900 feet into the rock. The easterly course will meet a heading from Lenox avenue under One Hundred and Fourth street, and the westerly proceeds, at one point over one hundred feet under the street line, to meet the tunnel at the Boulevard, making a long curve under the buildings at One Hundred and Third street.

Along the Boulevard the work is also in an advanced condition. Here, in a great many places, as was the condition in the downtown section of the city, the work of supporting a live load of heavy transportation had to be accomplished, and in some portions, where a three-track accommodation was secured, the whole system of trackage has not only been supported, but has been carried to a considerable distance to one side or the other.

The roadway will emerge from the ground at a point near One Hundred and Twenty-seventh street and a steel viaduct will be built across Manhattan Valley to One Hundred and Thirty-fifth street, where the roadway again goes underground. At this point a long brick wall on either side, originally placed for a two-track roadway, was, in accordance

with a change in the original detail, moved in one piece for a distance of ten feet in each direction. At One Hundred and Fifty-eighth street and the Boulevard, a dirt tunnel is being bored, requiring a most intricate and interesting method of sustaining the vault prior to the formation of the concrete arching. Another viaduct will carry the roadway across Spuyten Duyvil creek, from which point it will be elevated to its terminal in Kingsbridge.

The general scheme of construction has been to use concrete arching only where the weight overhead has been self-sustaining, as in the rock tunnels, or where a considerable depth underground had been worked through. Where purely structural work has been done the edges of the excavation are faced with a single-brick wall; inside of this a bed of concrete is moulded and next to this a weather-proofing of tar-paper and asphaltum, and in some places asbestos. The ironwork is built against this, and when the roof is in place the sheathing entirely encloses the work.

The utmost care and closest watchfulness are directed against the contingency of accident. In the rock tunnels the drilling is done at night, and the blasting early in the morning. Air pipes are run into the piercings to rid the chamber of vapors, and after each blast a corps of "tappers" make an advance survey and where a cleavage is discovered it is immediately made safe. Special precaution in safeguarding these points is provided in the subsequent work. It is remarkable that at the points where there has been real danger there has been no loss of life and, on the whole, the fatalities have been very few.

135TH STREET AND BROADWAY. (STRUCTURE READY TO BE WIDENED.)

Pilgrimage Made Easy.

A despatch to a Philadelphia newspaper says: Cleveland and Chicago capitalists have applied for concessions for electric lines from Cairo, Egypt, to Mount Sinai, and thence along the coast of the Red Sea through Syria and Arabia to Mecca with a branch to Damascus.

Electricity on British Warships.

The extension of the use of electricity in the warships of the British Navy in place of steam for subsidiary purposes is to be made the subject of a series of experimental tests. At the present time the capstan, steering engines, ventilating fans and derrick hoists on men-of-war are worked by steam-power, and involve the construction of a regular network of pipes in the interior of the vessel. In the new armored cruiser, Hogue, now being completed at Devonport, all the auxiliary gear will be worked by electricity, as well as the gun and torpedo armament, as at present. If the experiments prove successful the innovation will probably be extended to all ships that have to be refitted, as well as to ships that are now in the course of construction. An electrical staff is already part of the complement of a modern man-of-war, so that there will be no need for alterations or additions to the crew. A great economy of space will be effected by the change.

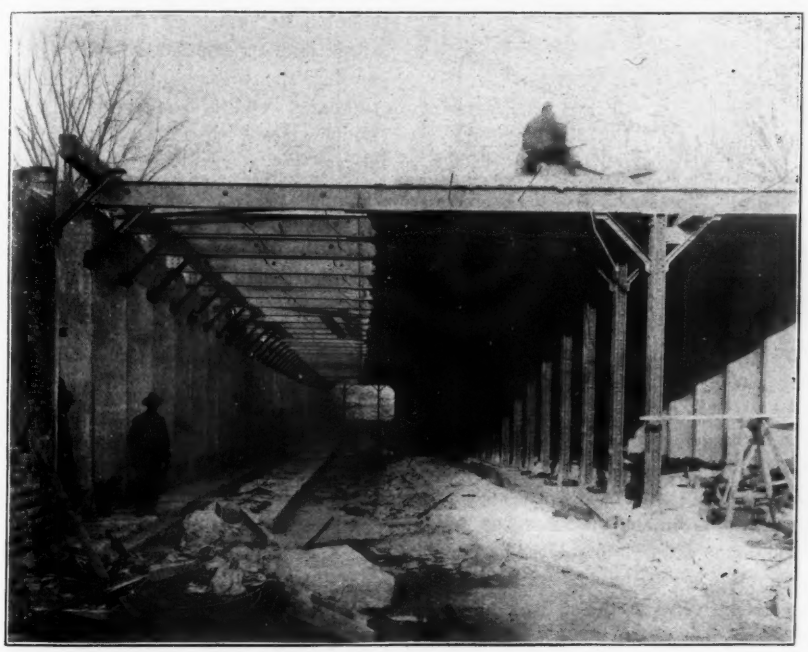
In a recent issue of *La Revue Générale des Sciences,* M. Ch. Maurain describes experiments on the behavior of metals deposited electrolytically in a powerful magnetic field. With iron deposits the magnetization in general does not attain its maximum value until the thickness of the deposit exceeds about eighty-three millionths of a millimetre, though with very intense fields the normal state is attained with thinner films. Such deposits form very permanent magnets.

The Belgian Government has passed plans for an electric railway between Brussels and Antwerp.

135TH STREET AND BROADWAY, SHOWING 250-TON BRICK WALL—ONE TO LEFT HAVING BEEN MOVED TEN FEET—ONE TO THE RIGHT READY TO BE MOVED.

The Means and End of Education.*

The discussion which followed Professor Perry's address on "The Teaching of Mathematics," delivered to the British Association at Glasgow on September 14 last, proceeded, unfortunately, much on the usual lines of destructive criticism, and we do not think it went to the root of the matter at that. It comprised a skirmish round the question of concrete *versus* abstract training, an attack upon and weak defence of Euclid's elements, and a wholesale denunciation of examination. Neglecting the first point of dispute, and admitting out of hand that we have no particular affection for the Alexandrian philosopher, we may still venture to doubt whether the ban under which his methods have fallen is altogether justified. If, by reason of the aversion shown by most people from original thought, and the facility they display in thinking illogically, we grant that majorities are always wrong, we are met with the antagonistic phenomena that the head masters of England plump for Euclid, while all the nations of the earth, save Great Britain, have cast him from his throne. But in spite of foreign example, it would seem that Euclid is to some extent bound up with the system of examination, partly because he is already in possession of a text-book and partly because the intelligence with which he has been studied appears to lend itself with peculiar readiness to an examinational test. We are willing, nay, anxious, to admit that to test education by examination is theoretically wrong; to educate, or, in plain words, to "cram" a boy merely in such fashion that he may pass a board of examiners with little fatigue and flying colors is practically, as well as theoretically, absurd; and the more closely we approach so-called scientific subjects, the more plainly is the absurdity evident. But here we are met by the grave difficulty that some test of education must be retained or devised. John Bull sends his son to the care of the Rev. Mr. Smith to school, desiring that he may obtain a better education than his father ever had.



135TH STREET AND BROADWAY—STRUCTURE WIDENED TO ACCOMMODATE THREE TRACKS.

Ex hypothesi Bull is unable to estimate the value of the results; but, as a commercial man, and one of common sense, he must be assured he is receiving a good return for his money. As a matter of business he can not accept Mr. Smith's assurance on this point; and even Professor Jones, or a board of Professors Brown, Jones and Robinson, does not necessarily inspire him with confidence. But if Brown, Jones and Robinson are accepted, foolishly or not, by most people in the country as competent examiners, he will accept their verdict; and, what is more cogent, the firm into which Bull hopes to put his son will accept it too. The system is admittedly bad, for its utility depends on the common sense rather than on the deep knowledge possessed by the board; and, unless the members of that board are demi-gods, they must, at least to a large extent, "standardize" their business. Nevertheless, before we can abandon all examinations, we must have something distinctly better to take their place.

We can not help thinking that our whole method of education is wrong. We appear to want a scheme whereby every child shall be sent to a new, but more or less uniform, establishment in which two processes shall be simultaneously conducted under a mixed staff of trained teachers, and what, for want of a better term, we may call psycho-physiologists. The child shall be taught the "three R's" as the indispensable minimum and possible maximum, and during the operation the physiologists shall watch him carefully but unobtrusively until they can decide whether he has enough brain to be worth educating, and whether his body is sound enough to nourish that brain. If the verdict is adverse, let him go to the plough or to the bench without delay. If he pass the test, let him proceed to a higher establishment, still under psycho-physiological supervision; and after several such weedings out, let him pass to the place or places where he can be trained to the utmost. The law of heredity and the doctrine of averages teach the same lesson: There is much greater probability that the son of an educated man will yield good value for education than that the son of the dock laborer will do so. Yet there are sports on both sides. The son of a philosopher may be an idiot: the son of the navvy a Clerk-Maxwell. At present we are so afraid of missing the regenerate sport—which would be a dire calamity—that we squander time and energy over the degenerate variety and the infinitely commoner normal specimen of untrainable youth—which is more than equally sad. The whole of the country's money that is available for education is used up in giving a free training to the children of those very classes of the community from whom there is least likely to be any return; and so, except in Scotland, the fees demanded for middle-class and secondary education are heavy. The member of the upper middle classes is hunted with peculiar malignity by the tax and the rate collector; he is compelled to find the wherewithal to teach his servants' children French and art needlework; his own son must enter an office at fifteen to keep his father out of the Bankruptcy Court. However much we may introduce machinery into the affairs of everyday life, there will remain a considerable quantity of manual labor to be performed—labor which requires nothing beyond obedience for its successful performance; and, there-

* An editorial article from the London *Electrical Review.*

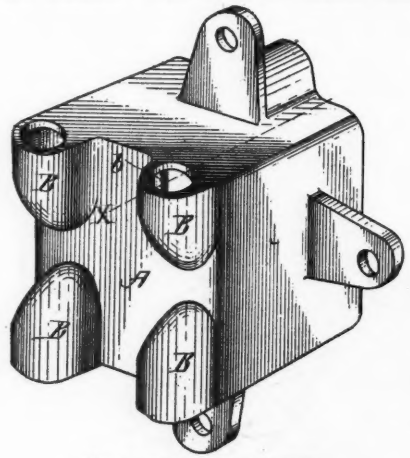
fore, till the millenium arrives we shall need the laborer, as the army still seems to need the private. There will always be hosts of individuals among us deficient in brain power, and multitudes of those still more unfortunate persons whose inherited diseases (including those of crime, insanity and alcoholism) will prevent their using the brains they possess to the advantage of the nation. Why should we rob their luckier and more important brethren of the opportunities for the utmost mental culture, in order to give them a smattering of information useless and detrimental to themselves?

Of course, Professor Perry's views on the teaching of mathematics are sound. It is obviously requisite that educational methods shall be modified to suit the student, while retaining sufficient uniformity to fulfill the requirements of the harmful but necessary examiner; and it is equally requisite that subjects shall be taught in such a way as to make them interesting—not so much in order that the said subjects may be remembered, as that a love of learning shall be cultivated. We have a lively recollection of a headmaster, not a specially deep mathematician, who managed to introduce humor and interest even into his Euclid class, so that the boys understood what they were dealing with and looked forward with pleasure to the next proposition. But we do still assert that the primary end of education is not to teach things or subjects, not even to create a memory; the idea is to teach the learning faculty, and to train the brain to think logically. A man's brain should not be loaded up with facts and dates and operative processes (we mean the brain of a man of affairs or of a scientific consultant); the places for these are the shelves of his bookcase, and the library of the British Museum. His brain should be exercised and polished until it is capable of marshaling facts which he or his subordinate has collected from the books or the laboratory—marshaling them intelligently on the one side and the other until he sees whither the evidence points, until he can pass a sound and logical judgment on the problem submitted to him.

In reference to gaslight mantles, it is reported that an Austrian engineer has discovered and perfected a chemical compound which, when added to the thoriacera mantle, converts it from a loose, fragile structure into an elastic glass, where the chemical constituents are chemically combined, and not merely mechanically held together.

Electrical Patents

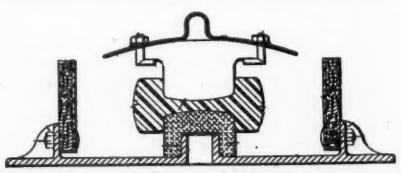
A new switch and outlet box that claims decided advantages over the old forms has just been patented by Mr. Miner Robinson, of Newton, Mass. These boxes, as ordinarily constructed, have openings either in the back or side of the body for conduits to enter, or some employ thin partitions or plugged holes so arranged that when the partitions or plugs are removed the openings are left to receive the conduit. The inventor claims that



Switch and Outlet Box.

both arrangements are impracticable for various reasons. First, the flexible conduit is not securely held in place, and second it is liable to be either pulled through too far or pushed back when the switch is installed, thereby allowing the wire to contact with the edges of the openings. Further than this, as the switch usually takes up practically all of the space in the side of the box, there is room for the conduit to enter only a very short distance. In order to overcome these defects, instead of providing openings directly through the walls, Mr. Robinson provides pockets on the exterior of the body, these pockets communicating, however, with the interior through suitable openings made for the purpose. They are preferably bent or curved so as to receive the conduit not at right angles to the wall of the box on which the projection or pocket is made, but substantially parallel or slightly oblique thereto. They form practically elbow joints and securely hold the end of the conduit from being pushed too far into the box, for the reason that a slight bend is made, and the side of the opening grips the conduit so as to prevent its movement in either direction.

Mr. Charles Hansel, of New York city, has patented an improvement in the third-rail system, his object being to provide a simple and efficient cover or shield for the same, also to employ a support whereby vertical movement between the conductor and the roadway structure is permitted, and an anchor which will prevent the gripping of the conductor with relation to said roadway structure. The invention is particularly directed to that type of conductor or third rail which has a pair of oppositely arranged contact surfaces adapted to cooperate with a double trolley device, which was patented by B. C. Seaton, in 1898. The conductor shown consists of a rail having a pair of heads forming the contact surfaces, said heads being connected by a web. The rail is loosely supported on an insulating block, which is adapted to engage the web and fill the space between the lower portions of the heads, so as to prevent lateral movement thereof. The blocks are provided on their under sides with recesses, which loosely engage the upwardly extending bosses of the base. A continuous metallic shield is located above the conductor and is extended outwardly beyond both sides thereof and is slightly bent downwardly from the centre in each direction, so as to form dripping edges, by which the moisture will drip clear of the contact surfaces of the conductor. The shield is supported by and insulated from the conductor, there being provided for this purpose a series of separated insulating supports, each consisting of a block of insulating material which is adapted to engage the web of the conductor between the heads. The blocks are rigidly secured to the web by means of bolts, the heads of which are located in re-

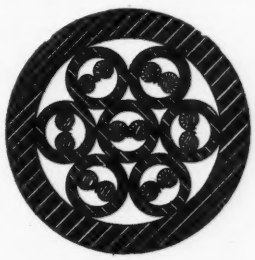


Electric Railway Conductor.

cesses formed in the upper sides of the blocks. The shield is rigidly secured to the blocks by means of the bolts, having heads adapted to engage the under side of the out-turned flanges of the blocks. A pair of guard-rails are preferably arranged on opposite sides of the conductor, with their upper edges adjacent to the outer edges of the shield. These guard-rails are preferably formed of wood, with a metallic lining on the inner surface thereof, these parts being secured together and to the upwardly projecting brackets carried by the base by means of bolts. It will be seen by the construction described that vertical movement between the conductor with its shield and the roadway

structure is permitted, but that lateral movement between said parts is prevented. In order to prevent longitudinal creeping of the conductor and its shield with relation to the roadway structure an anchor is provided, which preferably consists of a piece of plate metal, one end of which is secured to the conductor and the other end of which is preferably bifurcated and secured to one of the sleepers of the roadway structure. This form of anchor, while effectually preventing the creeping of the conductor, will not interfere with the vertical movement which inevitably takes place between the conductor and the roadway structure as the train passes thereover.

In the existing types of telephonic or telegraphic low-capacity cables, subterranean as well as submarine, every effort is made to insulate the conductor with a dielectric having a total electrostatic capacity as low as possible, but without due regard as to how this total is made up—that is, as to how the capacity is distributed around the conductor or between the conductors in case of multiple conductors in the same cable. If a cross-section of such a low-capacity cable be examined, it will be found to have an irregular form, which, moreover, will vary at different points of the cable if several sections be taken, so that there is always a different and varying shape in the dielectric surrounding each conductor. This is due to the old method of covering, in which the conductors are separated, for instance, by thin strips of paper, which get distorted into all sorts of shapes, quite preventing any symmetrical arrangement of the conductors within the cable. Mr. George E. Heyl-Dia, residing in Warrington, England, has obtained a patent in this country on an improvement in this class of cables and the process of manufacturing the same; his purpose being to increase the efficiency of such cables, and to obtain a greater flexibility which obviates the danger of ruptures of the insulation material in bending. According to the present invention the dielectric is always distributed uniformly about the conductor or conductors, which are maintained symmetrically within the cable, so that there will be found practically the same conditions around one wire as there are around its fellow wires, and undulatory currents can be transmitted with a minimum of distortion. By this uniform distribution of the capacity it is rendered possible in the case of long-distance telephony; for instance, to properly reproduce speech, as inductive disturbances from either pairs of conductors or from single wire to single wire are effectively eliminated, and even on short cables the speaking efficiency is increased. This increased efficiency of the cable is due not only to the uniform distribution of the dielectric or electrostatic capacity around and between the conductors, but also to the less deterrent effects of the magnetic fields formed by current motions or waves, which in the improved cable are not distorted so much. In order to attain the object of the invention, the stranded or plain conductors are covered with paper strips, having a broken surface consisting of numerous pyramidal or pointed projections broadening to their bases, formed closely together by grooving the paper in cross-hatch form on either or both faces, and folding the same longitudinally about the conductor in the desired number of layers, with a winding of thread to retain the paper. The con-



ELECTRIC CABLE.

ductors thus separately covered may be laid up in one or more pairs into a single cable, and the meeting edges of the paper are arranged to well overlap and form an increased thickness at one side of each conductor and place this thickened part of one conductor against the corresponding thickened part of its related conductor in each pair. The combined thickness thus produced between the two conductors approximates to the combined thickness of the non-thickened parts and of the thicker enveloping insulation around the pairs, thus ensuring the same conditions and even distribution of the dielectric or electrostatic capacity all around each conductor of the pair, as there is an even thickness of the insulating material both around and between the conductors of the cable. This can not be attained with the usual inserted paper strip or with a spiral winding of the material on the separate conductors, which after the enveloping winding of a thicker layer would produce a greater thickness of insulation about the pair than between the two conductors. It will be seen, moreover, that the paper touches the conductor only at numerous fine points and ensures a thorough air-space character for the cable without losing the symmetrical arrangement of the conductor, as is the case with the usual paper strip inserted between the wires, which in laying up the cable becomes distorted. The building up of the conductors into cables may be effected by squirting paper-pulp around them or wrapping on paper in the ordinary way, or they may otherwise receive a final insulation or protective covering of any of the usual kinds. The peculiar surface of the improved paper strips renders them well adapted also for the final or enveloping insulation of the cable, as not only are uniform and ample spaces provided for air or fluid insulation by the layers only touching at numerous fine points, but great flexibility is afforded, which is so much needed, particularly when the cable is to be used for electric light or power, and danger of rupture of the insulation in bending, to which paper cables are liable, is obviated.

A Complimentary Dinner to Railway and Light Employés.

On the evening of January 2 the Lancaster County Railway and Light Company, of Lancaster, Pa., gave a complimentary dinner to the men in its employ, numbering very nearly 400. Nearly all of the employés of the Conestoga Traction Company, the Edison Electric Illuminating Company, the Lancaster Gaslight and Fuel Company and the Columbia Electric Light Company, which are coordinate concerns operating under the Lancaster company's title, were present. The dinner followed closely upon an announcement made by the traction company that after January 15 the wages of conductors and motormen would be voluntarily increased by the company ten per cent.

The dinner was the second event of its kind, the custom of giving an annual dinner having been inaugurated by President W. B. Given last year. The operation of the entire trolley system was suspended between 9 and 12 P. M., in order to give the uniformed men a chance to attend, and substitute engineers and firemen were employed in the power-houses and gas plant so that every employé might be present. Those present included, besides the president, officers and employés of the company, the local members of the board of directors, Mr. Chas. A. Bragg, of Philadelphia, representatives of the press of the city and county, and other guests.

Experiments made to determine the loss ensuing by exposing coal to the weather, unprotected in any way, show, contrary to general belief, that it is very small. There was a gain in the amount of oxygen but a loss of carbon, hydrogen and nitrogen; the loss of calorific power was slight.

A DINNER TO MR. MARCONI.

THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS ENTERTAINS THE INVENTOR OF WIRELESS TELEGRAPHY AT ITS ANNUAL BANQUET.

On Monday evening, January 13, the American Institute of Electrical Engineers tendered to Mr. William Marconi a dinner, the event taking the form of the annual banquet of the Institute, at which Mr. Marconi was the guest of honor. The dinner was given in the Astor Gallery of the Waldorf-Astoria Hotel, in New York city, and about 300 members and guests, including many ladies, were present.

The occasion was one of the most interesting and delightful in the history of the Institute. The large hall in which the dinner was served was beautifully and appropriately decorated with electric lights, the designs having special reference to Mr. Marconi's recent transatlantic telegraphic exploits. The names of the two stations in Cornwall and Newfoundland were emblazoned in electric lights at the ends of the hall, while a cable (unhappy thought) connecting the two was studded with lamps in groups of three to represent the three dots of the telegraphic letter S.

The guest table was at one side of the hall and seated at it were the following gentlemen: President C. P. Steinmetz, Professor Elihu Thomson, Professor Alexander Graham Bell, Professor Dr. Michael I. Pupin, Francis B. Crocker, Sir Percy Sanderson, the British Consul-General at New York; Signor Cavaliere A. Branchi, Italian Consul-General at New York; Mr. Arthur Williams, president of the New York Electrical Society; Mr. Carl Hering, Mr. Frank J. Sprague, Mr. T. C. Martin and Mr. Charles W. Price.

When the dinner had neared its end and the ices were brought in it was seen that the liberal fancy of the caterer had disposed the latter in the form of lightships and telegraph poles (with broken wires), yachts and other marine emblems representative of recent wireless telegraphic work. In opening the speaking President Steinmetz said that he regretted the absence of Mr. Edison, the founder of the electrical industry and the dean of the profession in this country. He spoke of the work of the telephonists and telegraphers and introduced as toastmaster Mr. T. C. Martin, editor of the *Electrical World and Engineer*. Mr. Martin has achieved the distinction of being almost the titular toastmaster of the Institute, by reason of his particular merit in this respect. Mr. Martin was exceedingly felicitous in his opening talk and read a number of letters, including one from Mr. Edison. "I am sorry that I am prevented from coming," Mr. Edison wrote, "especially as I would like to pay my respects to Mr. Marconi, the young man who had the monumental audacity to attempt and succeed in jumping an electric wave clear across the Atlantic Ocean."

Mr. Nikola Tesla wrote that he wished to join with the members of the Institute in congratulations to Mr. Marconi on his splendid results. "He is a splendid worker and a deep thinker," Mr. Tesla wrote, "may his powers increase and reach out for the good of the world and the honor of his country."

Letters were also read from Mayor Seth Low, Captain Chadwick, of the navy, and others. A number of cable messages addressed to various sister Italian societies were then read by Mr. John W. Lieb, Jr., whose excellent Italian pronunciation seemed immensely to please the guest of honor.

Mr. Marconi said:

"I can hardly find words to express my gratitude and thanks for the reception I have received here to-night. I thank you very much for the appreciation of the work which I have been fortunate enough to carry out. I feel myself highly honored to be entertained by such a great body as the American Institute of Electrical Engineers. I think it is well known all over the world that Americans stand first in applied electrical engineering. I feel myself greatly honored to be in the midst of so many eminent men, whose names are household words in the whole civilized world.

"With your permission I will give you a brief description of what my system has at present accomplished, especially in reference to use on ships, and what I hope it will accomplish in the future. Wireless telegraphy is now attracting very great attention all over the world, and its progress is not slow. Five years ago the system with which my name is identified was working over a distance of about two miles, but its range has been rapidly increased until a few months ago it was quite possible to communicate by means of an improved and attuned system over a distance of 200 miles. The commercial application of the system has been given serious consideration, and improvements have been made of importance.

"It may interest you to know that the commercial application of the system has been tried in Great Britain, its chief base being in England. It may interest you to know that there are over seventy ships carrying permanent installations for wireless telegraphy. Of these thirty-seven are in the British Navy, twelve in the Italian Navy, and the remainder are on the large liners, such as the Cunard Line, the North German Lloyd and the Beaver Line. There are over twenty stations in operation on land in Great Britain, and more are in course of construction.

"I regret very much that it is impossible for me in a brief address to go into the scientific details and the scientific development of my system. I would like very much to do so, but I can not at this time. I think it is right that I should correct some of the popular opinions which prevail as to the subject of wireless telegraphy.

"It seems to be the general opinion that when a message is sent into space any one with a necessary apparatus can intercept that message and read it. Of course this would be very awkward and would hurt the system from a commercial standpoint. No one would wish to have his private affairs made public in that way. For instance, stock quotations or other matters of secret could be found out. By experiments and improvements which have been made, messages can only be read when the receiver and the transmitter are attuned.

"This perfected system is not at present in use on the ships. It has been deemed necessary that each ship should be equipped with apparatus which will permit of its reading a message sent from any other ship, because of the possibility of aid being required. Therefore all ships are attuned so that one ship can call up any other ship, but it is practicable to have the apparatus so attuned that the messages transmitted can in no way be received by any other apparatus except that attuned to receive the message."

Mr. Marconi then went into the subject of his early experiments and the aid rendered to him by the British Government. He said:

"In a paper read before a body of electrical engineers in Europe by Professor A. Fleming, the professor of electrical engineering of London University, he states what was done by Marconi in transmitting messages by the wireless system. He said—and I am quoting Professor Fleming—that communication was established between Portland and Portsmouth, a distance of about sixty miles, with intervening hills of 800 feet in height. Crossing these stations two other stations had been placed in operation, and it had been found that crossing messages did not in any way interfere with one another. Transmission of messages was also obtained between England and Ireland, two stations located a distance of 200 miles apart, and with the use of a very small amount of energy— about as much energy as is necessary to light a small incandescent lamp—messages were transmitted. Professor Fleming says that with the installation of more powerful machines the radius would be greatly enlarged."

Mr. Marconi described the arrangements he made for sending a message

across the Atlantic Ocean. He told of the troubles he had in obtaining a station at Cape Cod, caused by the hurricanes, which delayed his work several months.

He then told of his determination not to wait three months so that repairs could be made to the Cape Cod station, and instead he went to St. John's.

"I thought it might be useful in some way to go to a station somewhere where a temporary installation could be arranged," said he. "I did not think that it would be prudent to try to send a message a distance of 3,000 miles—to send a message across the Atlantic—unless my apparatus was permanently installed. That is the reason I went to St. John's, Newfoundland, which is a distance of 2,000 miles from England. It was necessary here to use kites and balloons, with the necessity of which you are pretty well acquainted. The kites and balloons gave us a great deal of trouble to get them at the proper height, because of the wintry gales. But it was found on December 12 for the first time that we got the kites in a proper position, and we got messages from Cornwall at the right time, and at the prearranged speed." [Cheers.] "Experiments would have been continued except for the bad weather conditions and also the discovery of the fact that the Anglo-American Cable Company claimed to have the monopoly of all telegraphic communication in that colony—not only of all telegraphic communication, but of all experiments in any way connected with telegraphy. They claimed to have the right over the land and the sea. This was rather strange to me, and I mention it because of the different treatment I received at the hands of the English Government.

"The British Government claims a monopoly of the telegraph, but I am glad to say that they have encouraged my experiments more than prevented them. Certainly when it comes to commercial work in establishing a station between England and ships, we shall come to an arrangement, and suggestions have been made for future plans. The manager of the cable station at St. John's was pleased that I provided a revenue for the company because he told me that during the three days I was there they sent 50,000 words over the wire."

Mr. Marconi then discussed the future of wireless telegraphy at length. He said he had not the slightest doubt that in the near future it would be possible to send many messages over the sea at the same time by instruments properly attuned. He said:

"I have been very greatly encouraged by the government of Canada and the sympathy they have given to me has encouraged me in my work. I think it will be admitted that one of the greatest features of civilization in all the world is the facility with which people can communicate with each other, living long distances apart. My hope is that at no great distant date I shall bring my system to the point of perfection of allowing friends and relatives to communicate with each other across the ocean at a small expense.

"At present by the existing cable system the sending of messages across the seas is put out of the reach of people in moderate circumstances. The cost of laying the cables is so large that cable companies have to charge a high price for the service. My system will cheapen the cost very greatly, and do away with all cables and the charge for their care.

"I have built very largely on the work of others, and before concluding I would like to mention a few names. I may miss a few of them, but I would like to mention Clark Maxwell, Lord Kelvin, Professor Henry and Professor Hertz. I do not know if you are aware that the message received at St. John's was received through a telephone receiver, and in connection with the telephone the name of Professor Alexander Graham Bell is inseparable.

"I hope that I may bring this work to a successful completion. As a stranger here I thank you very much for your kind expressions and for your hospitality, and I have the honor to drink to the health of the American Institute of Electrical Engineers."

Enthusiastic applause greeted this unusually modest address. Mr. Marconi speaks distinctly and slowly, without gestures, and the fact of his Italian origin can not be discerned in listening to his excellent English. The impression he made upon his audience was most happy. Though youthful in appearance he exhibits, to some degree, the hard strain under which he has been working, but he seems entirely to have avoided the pitfalls of adulation spread for him.

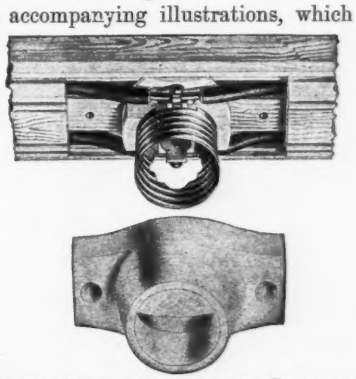
Professor Elihu Thomson spoke briefly, dwelling particularly upon the importance of the scientific side of the work which Mr. Marconi has been doing and upon the fact that if his results had been without practical value they would have been of enormous importance to science. He spoke of the obstacles which stand in the way of all scientific progress and of the scientific spirit which allows no obstacles long to interrupt its advance. He made a very beautiful and picturesque statement of the gamut of electrical vibrations, from the slow electrical waves used in alternating-current practice up to the almost infinitely swift oscillations exhibited in the X-rays. In concluding his remarks Professor Thomson said that to-day when we send an urgent message to a friend we generally wind it up with the statement "Wire reply." In days to come he believed we would have to say "Answer coherently." Professor Thomson's remarks were greeted with prolonged applause.

The toastmaster related entertainingly some stories bearing upon the subject matter of the evening (and other matters) and introduced as the last speaker Dr. Michael Pupin, of Columbia University. Dr. Pupin spoke at much length. By a series of diagrams he exhibited the logical development of wireless telegraphy from the two varieties of telegraphic circuits. He entered at length and with much detail into the interesting questions involved in research upon electrical wave motion.

The guests arose from the tables at midnight, and Mr. Marconi held a short informal reception in the dining-room. The dinner was one of the most entirely satisfactory occasions of its sort which have marked the history of the Institute. The committee of arrangements, of which Mr. Calvin W. Rice was chairman, accomplished most creditable results in a very short time, and deserves no small measure of praise for its success of the evening's entertainment.

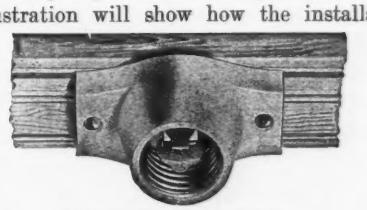
AN: w Receptacle for Moulding Work.

There has long been felt by electric light contractors and wiremen the need for a simple and economical receptacle to be used with moulding work. To meet this demand the H. T. Paiste Company, of Philadelphia and Chicago, has brought out the interesting little device shown in the accompanying illustrations, which is



MOULDING RECEPTACLE, SHOWING CONNECTION.

known as the "P.-K." fielding receptacle for moulding work. To install this appliance neither the wire nor the moulding has to be cut, a point that will be appreciated by any wireman. A glance at the illustration will show how the installation is accomplished. These receptacles can readily be applied to old work, it being necessary only to lift off the capping of the moulding, pull up a little slack wire, skin it, and slipping it under the inside of the receptacle, replace the cover.



MOULDING RECEPTACLE.

Electric Hoists.

The old-fashioned hoisting engine, one of the most noisy, inefficient and generally unsatisfactory pieces of apparatus that was ever devised, is rapidly giving way to electric hoists which combine numerous features of merit for this class of work. The accompanying illustrations represent various types of electric hoists manufactured by the C. W. Hunt Company, of West New Brighton, N. Y.

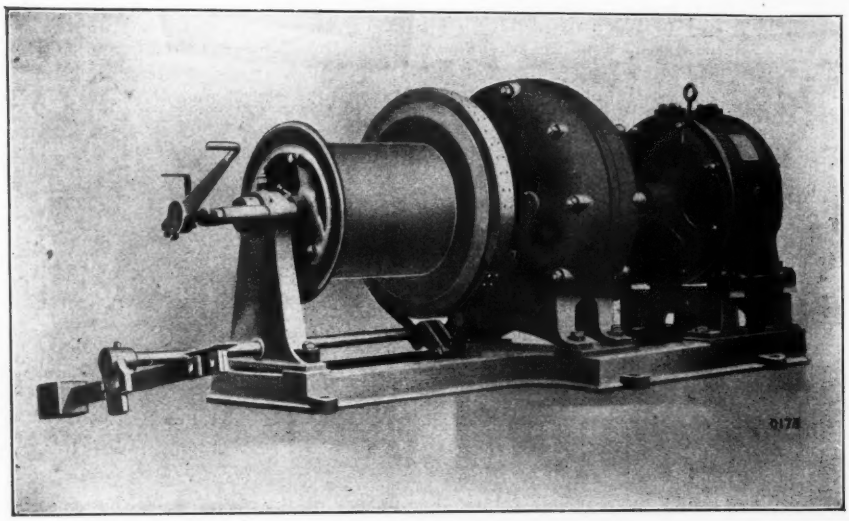


FIG. 1.—ELECTRIC COAL HOIST.

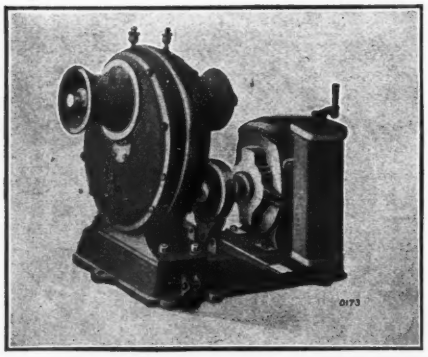


FIG. 2.—DOUBLE-SPOOL WHARF WINCH.

In Fig. 1 is shown a coal-hoisting apparatus complete. This machine consists of the driving motor, the necessary gear and the rope drum, and is manufactured in sizes capable of handling loads up to five tons, at any speed within the limit of usual practice. The machine is made of capacities between 50 and 600 feet per minute, and with motors adapted to run either on direct or alternating current, and of any desired make.

In Figs. 2 and 3 are shown, respectively, a double-spool wharf winch for cargo handling, and a double differential drum steam-shovel hoist, which means an apparatus adapted to be used in place of the ordinary steam mechanism connected with steam shovels.

On all of these apparatus a friction clutch is an essential and particularly important adjunct. If the clutch is such that the load starts too quickly, taking up the spring of such ropes, masts, gaffs or other appliances as are included between the hoist and the bucket, it will cause a sudden jumping movement of the latter, causing timidity in the men feeding the bucket, and resulting in slow and inefficient work. The necessity for using friction clutches also involves the necessity for carefully ventilating the drums and friction surfaces of such apparatus. This is accomplished in these machines by making the spokes of the drum in the form of propeller blades so that whenever the drum revolves, either in hoisting or lowering the load, a current of air is forced over the heated surfaces.

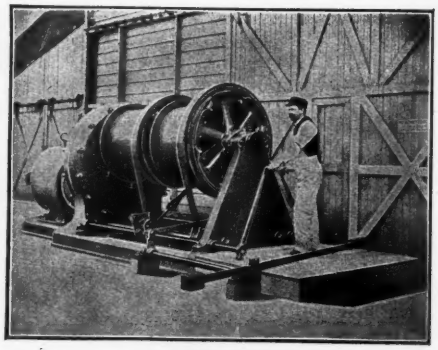
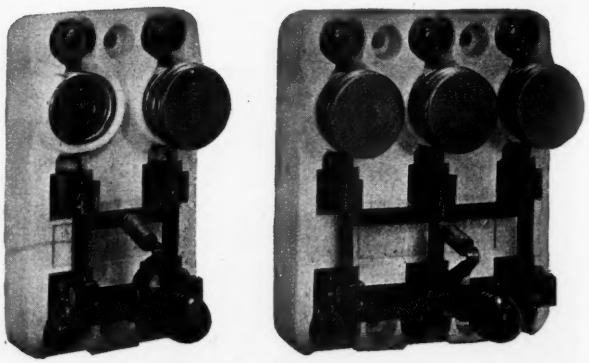


FIG. 3.—STEAM SHOVEL HOIST.

Only spur tooth gears with accurately cut teeth are used in the construction of this apparatus, the pinions having twenty-one or more teeth, and all of the gears are enclosed in oil-tight and dust-proof iron cases and are operated in oil. Powerful band brakes are applied to the end of the drums opposite the friction clutch, so that the heat generated in one may not affect the working of the other. Napier differential levers are used, making the handling of heavy loads easy for the workmen. All the brakes are lined with wooden blocks, which are renewable when worn, and all of the motors are connected with the hoist through flexible couplings, so that slight changes of alignment do not affect the performance of the apparatus. It is claimed by the makers that the overall efficiency of this apparatus is higher than that of steam or air-driven hoists, and sufficiently so to exhibit a considerable saving during the course of a year's operation.

New Fusible Switches.

A very satisfactory form of fused switch has been put on the market by the General Electric Company. It consists of a combination of the well-known punched clip spring switch with the Edison fuse plug and is designed for 1,125-volt service.



NEW FUSIBLE SWITCHES.

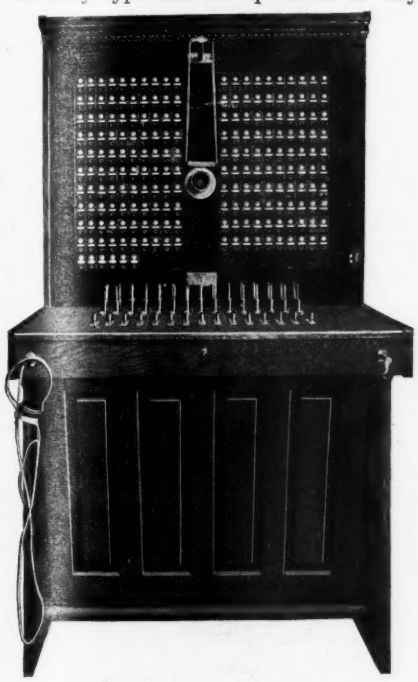
The use of this form of fuse has made the operation of re-fusing a switch a perfectly safe and simple matter which can be performed without tools. This feature, combined with the protection which the Edison plug ensures, makes this new switch desirable for use in many places where other forms of switches could not well be installed.

This device will be found very useful in connection with small motors, arc and incandescent lighting circuits, etc. The parts are mounted on a porcelain base, the entire construction being substantial and proportioned for severe usage. These are made with single-throw switches, either double or triple pole. The fuse plugs can be furnished with any capacity up to and including thirty amperes.

A Full Flashlight Signal Telephone Switchboard.

In the accompanying illustration is shown a switchboard of 200 lines capacity with 200 line signals and six electric light transfer signals in place. This board is made up in the cabinet type, so that additional cabinets can be mounted alongside of it giving increased capacity up to 1,000 lines without making any change in the original installation.

The switchboard is made for both magneto and central energy work. In the improved form of this board, which is manufactured by the Eureka Electric Company, Chicago, the cams used in the operator's circuit are of the double-lever type and are mounted on a shelf holding the electric light clearing signals as well as the cords and plugs. An ingenious arrangement, consisting of a self-contained automatic cut-off relay, is also employed on this board. The transfer arrangement is also of the self-contained automatic cut-off relay type and its operation is very

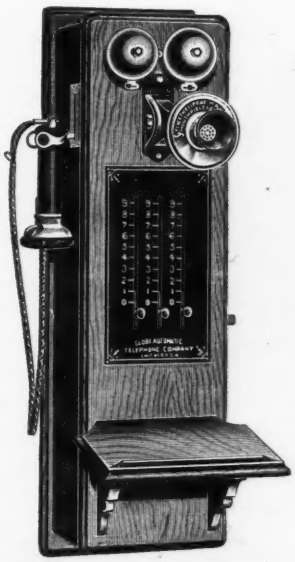


EUREKA SWITCHBOARD.

simple. An operator on one section of the board desiring connection with a line on another section, inserts a plug into the jack of the transfer relay and immediately lights lamp signals on both her board and that which she desires to call. The instant the called operator answers the lights are automatically extinguished. The simplicity and desirability of this system are obvious, and the rapidity of operation is claimed to be very great. As all of the relays are self-contained and are in units, as many as desired up to the capacity of a given cabinet may be installed.

Automatic Telephone Apparatus.

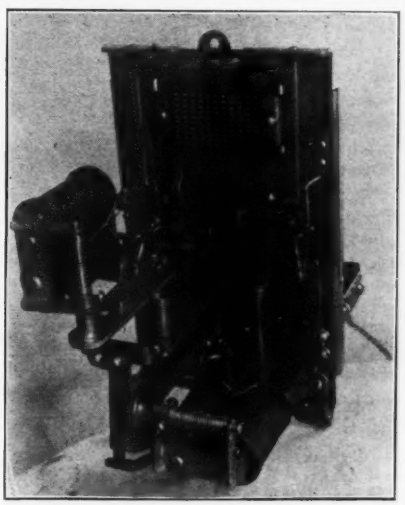
That type of telephone apparatus in which the necessity for a central-station operator is obviated by automatic apparatus is very rapidly coming into prominence and is attracting at present much interest. The accompanying illustrations show some types of such apparatus built



SELECTIVE AUTOMATIC TELEPHONE APPARATUS.

by the Globe Automatic Telephone Company, of Chicago.

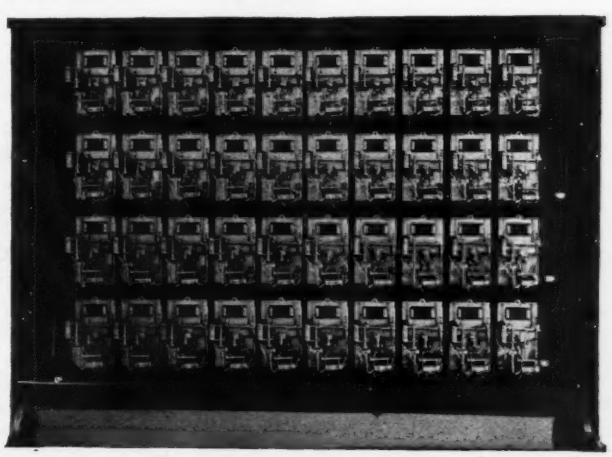
The wall apparatus shown is a standard type made with a capacity for 999 calls. The keyboard is so constructed that when the keys are placed opposite corresponding digits for the units, tens and hundreds, represented by the number of the desired call, and the receiver removed from the hook, the keys returned to their normal position, and while so returning operate step by step switches at the central office in such a way as to perform the required connection. If, for example, a subscriber wishes to call another, say, No. 625, he places the left-hand key on 6, the middle key on 2 and the right key on 5; removing the receiver from the hook and ringing his magneto in the ordinary way are the only further operations necessary to put him in communication with that subscriber. If the called subscriber's line is busy the bell will not ring, thus giving the busy signal. Disconnection is accomplished by hanging up the receiver, which instantly puts the whole apparatus in its former condition ready to receive or send calls. One of the accompanying illustrations shows an automatic drop or switch belonging to the 110-station capacity board manufactured by this company. The method of operation is that the first or hundred signal causes the carriage of the apparatus to move up a designated number of steps, a second or tens signal causes a cross movement, while the third or unit



SELECTIVE AUTOMATIC TELEPHONE SWITCH APPARATUS.

signal causes another vertical movement to the point desired, which is thus reached by a sort of coordinate system of motions of great simplicity. Another illustration shows a switchboard of this type for forty subscribers.

A reduction of fifty per cent in freight rates on the Belgian railways has been secured for all exhibits for the automobile exhibition to be held in Brussels in March.



SWITCHBOARD FOR FORTY SUBSCRIBERS.

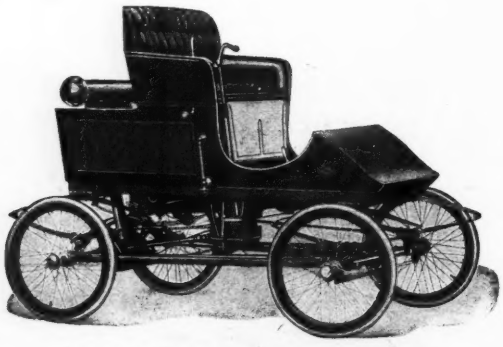
Some New Types of Automobiles.

The accompanying illustrations exhibit some details of steam-driven automobile carriages manufactured by the American Bicycle Company, New York, which are claimed by the makers to combine a number of ingenious and interesting features of merit.

American Bicycle Company's Steam-Driven Carriage.

Naturally, in a steam automobile one of the most vital and important points is the boiler. In what is known as the Toledo type of carriage here illustrated, the boiler is of the water-tube variety, combining within itself certain advantages of the shell type and of the flash type. The upper coils of the boiler form a superheating coil, while a centrifugal separator apparatus contained between the walls of the outer shell part causes the entire body of water to circulate artificially. A mud-settling drum or space below the line of fire permits the precipitation of such dirt or sediment as may be contained in the water, and this may easily be blown out by an appropriate mud valve. It is claimed that this variety of boiler possesses many points of safety in operation.

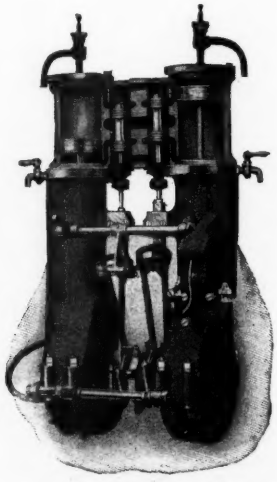
Boiler.



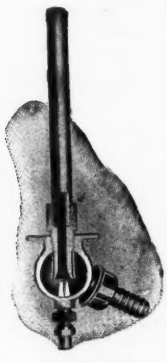
American Bicycle Company's Runabout.

The engine is of the ordinary reciprocating type using two cylinders, each three inches in diameter by four inches stroke. These engines are fitted with balanced piston valves and resemble in their general method of construction the better class of high-speed stationary engines. Their cross-heads are built of phosphor-bronze with very large wearing surfaces. The cranks run in baths of oil, the connecting rod being of the marine type, made of a steel forging, and the crank-shaft being of very generous dimensions. It is claimed by the makers that a consumption of only twenty-four pounds of water per horse-power-hour is exhibited by these small engines, showing a very high degree of efficiency.

The muffling arrangement, intended to get rid of the noise and annoyance of the exhaust, is so arranged as to combine also the functions of a feed-water heater. A siphon arrangement of the injector pattern is attached to these carriages, permitting live steam in the boiler to be used in filling the water tank from a stream or horse-trough or other place in which water may be found during a cross-country trip. The control of these carriages is effected by a single throttle and reverse lever combined giving the maximum of simplicity of operation. All of the air and gasoline tanks used are built of copper, tested to 200 pounds per square inch pressure. A hand brake of very powerful type is attached to each of the vehicles.



Engine.



Siphon.

These steam-driven carriages are made in a number of types, of which there are here illustrated two, one of which is intended for two passengers and the other for four.

Automobile Club of America.

Mr. J. Dunbar Wright, chairman of Foreign Relations Committee, addressed the Automobile Club of America, Tuesday evening, January 14, on "Some Automobile Experiences Abroad and in This Country." A supper was also served.

CURRENT ELECTRICAL NEWS

COMMERCIAL NEWS

DOMESTIC AND EXPORT

ELECTRIC PLANT FOR WINNIPEG, MANITOBA—T. L. Cooper, hydraulic engineer of New York city, is about to place contracts in the United States for an electric plant for Winnipeg, Manitoba. The initial expenditure will be about $50,000.

ELECTRIC COMPANIES FOR PORTO RICO—Among recent incorporations in Trenton, N. J., are the Ponce Electric Company, capital, $415,000, and the Ponce Railway and Light Company, capital, $50,000. Both companies are to operate in Porto Rico.

A NEW BRUSSELS COMPANY—Le Compagnie d'Electricite du Midi de la Russie (the South Russia Electrical Company) has been organized in Brussels, with a capital of some $650,000, for the purpose of constructing and operating a central electric lighting station at Rostoff-on-the-Don.

FRENCH SYNDICATE TO BUILD MEXICAN TRACTION LINES—It is reported that $16,000,000 has been subscribed in Paris for building and equipping a new system of electric street railways and introducing low fares in Mexico City, where the French syndicate, it is understood, has the cooperation of many prominent citizens.

TO IMPROVE NIAGARA PLANT—A majority of the stockholders of the Buffalo & Niagara Falls Electric Power Company has petitioned the Supreme Court to permit a mortgage of $500,000 being placed on the property. The Buffalo Loan, Trust and Safe Deposit Company has agreed to advance the money which will be used, it is said, in increasing the size of the plant. The company is capitalized at $500,000 and the mortgage will cover all of its assets.

AMERICAN DISTRICT TELEGRAPH COMPANY—Present indications point to a lively contest for the control of the American District Telegraph Company at the annual meeting on January 23. It is understood that there is some dissatisfaction with present management. A circular has been sent to stockholders for an expression of opinion as to the advisability of reducing the capital stock of the company from $4,000,000 to $2,000,000. It is stated that the business of the telephone has cut heavily into the company's business.

MORTGAGED FOR $3,000,000—A $3,000,000 mortgage on the Hudson River Electric Company to the Morton Trust Company, of New York, was recorded recently in the Saratoga County Clerk's office. It is a first mortgage to secure the issue of 3,000 five per cent coupon gold bonds of $1,000 each, covering real estate at Spier's Falls, the mammoth concrete dam across the river, the power plant, the right of way from there, a distance of thirty-nine miles, to Schenectady, the overhead wire, line poles, franchises, etc.

CABLE NORTH TO MEET THE SIBERIAN LINE—John T. Flynn, the representative of the Russian American Commercial Company, recently addressed the Seattle Chamber of Commerce committee on national affairs in regard to the construction of a transpacific cable. The company's purpose is to build a cable from Seattle to Juneau, thence to Valdes by land to Behring Strait and across to Russian territory. The estimated cost is $4,000,000. Mr. Flynn stated that there is enough business in sight to pay three per cent upon the cost of the enterprise.

ELECTRICITY IN UTAH—Great activity has been witnessed during the year just past. Throughout Utah there are now in use electrical plants which develop 19,300 horsepower. These installations are so situated that the electrical output may be increased at any time to 31,800 horse-power. Wide use is made of electrical energy by the mining and smelting interests of the state. The parent company in the electrical business is the Utah Light and Power Company, and has a capacity of 10,000 horse-power. Mr. R. F. Hayward is the chief electrical engineer of this company, and he predicts a prosperous future for electrical industries in the state.

WESTINGHOUSE COMPANY IN FRANCE—The Societe Anonyme Westinghouse—Westinghouse Joint Stock Company—has been organized in Paris with a capital of 20,000,000 francs for the purpose of extending the sale of Westinghouse electrical equipment in various Continental European countries. The new concern acquires the business of the Societe Industrielle d'Electricite, a company of 10,000,000 francs capital, which hitherto controlled the patent rights for manufacturing and selling Westinghouse electrical machinery in France. The new company will also control the market for Westinghouse electrical equipment in Italy, Belgium and Switzerland, and has the right to sell Westinghouse gas engines in all these countries.

ANOTHER MEXICAN STREET RAILWAY—Mexican advices state that C. S. Mackin and F. H. Dillon, of the engineering firm of Mackin & Dillon, of Monterey, and Eulalio San Miguel, attorney, of the same Mexican city, are at the head of a company formed for the purpose of establishing a street railway system in Torreon. With them are said to be associated Nuevo Leon and Coahuila capitalists. The company is to have an initial capital of $300,000, which is to be increased to at least half a million dollars when active operations begin. A concession for the building and operating of the system has already been secured from the government of Coahuila. Mr. Mackin is now in the United States in regard to the project, and operations will begin upon his return.

BIG JAPANESE ELECTRICAL CONTRACTS GO TO AMERICANS—The Tokio Tetsudo Kubushiki Kwaisha, a Japanese concern, has concluded arrangements through Mitsui & Company, of New York city, whereby American firms will furnish the equipment, valued at nearly $800,000, for the first electric traction system in Tokio, the largest contract of its description ever awarded for American machinery, etc., by a far eastern concern. The General Electric Company will build three 1,200-kilowatt generators. The three 1,800-horsepower compound horizontal engines are to be manufactured by the McIntosh-Seymour Company, of this city. There will be eight water-tube boilers, aggregating 4,400 horsepower, to be furnished by the Babcock & Wilcox Company, of New York. The Blake branch of the International Pump Company, of New York city, will build the pumping and condensing equipments. The 250 car trucks will be made by the Peckham Manufacturing Company, of New York city. The Morgan Engineering Company, of Alliance, Ohio, is to build a twenty-ton electric traveling crane. Chief Engineer Enyo, of the Tokio company, who has been in America for some weeks arranging details regarding the contracts, has left for Japan. On the eve of his departure he said that the road would operate in the principal streets in Tokio, and would be ready to begin operations early in 1903.

PERSONAL MENTION

MR. A. M. BARRON, president of the New Albany Waterworks Company, and also president of Franklin (Ind.) Water, Light and Power Company, is carrying forward great improvements and additions in the interest of his companies. Mr. Barron, in addition to these two important connections, has an extensive business as a consulting engineer.

MR. S. E. WAYLAND, general manager of the Lackawanna Telephone Company, of Scranton, Pa., the People's Telephone Company, of Wilkesbarre, Pa., and the recently formed consolidated Telephone Company of Pennsylvania, consisting of the independent telephone companies of the state, has been elected general manager of the Frontier Telephone Company, of Buffalo.

MR. HENRY L. SHIPPY, treasurer John A. Roebling's Sons Company, of New York, is remembering a multitude of his friends at the opening of the new year with vest pocket calendar, desk calendar and a memorandum book, all of which are highly appreciated. The memorandum book is in twelve sections, one for each month with day and date, and is one of those desirable things for a man's pocket that is used constantly.

MR. R. K. DANA, for many years agent and New York manager of the Washburn & Moen Manufacturing Company, has associated himself with the banking and brokerage firm of Messrs. Yates, Ritchie & Pope, of 18 Wall street, New York. This firm is a member of the New York Stock Exchange, and to accommodate its growing business has opened an office at 28 West Thirty-third street, New York, which will be under the management of Mr. Dana.

ELECTRIC RAILWAYS

AMHERST, MASS.—A new electric railway company is being formed to be known as the Hampshire Street Railway Company.

DAYTON, ILL.—The interests which have absorbed the Dayton, Lebanon & Cincinnati road have increased the capital stock from $500,000 to $2,000,000.

WESTFIELD, MASS.—The Lake Shore Traction Company, capitalized at $280,000, has asked for a franchise to build a trolley road from Westfield to Silver Creek.

CLYDE, N. Y.—A large power-house and a number of car shops, to cost about $500,000, are soon to be erected for the Rochester & Syracuse Electric Railway Company.

AUSTIN, TEX.—The Northern Texas Traction Company, of Fort Worth, has filed an amendment with the Secretary of State increasing its capital stock from $2,000,000 to $2,500,000.

MARION, IND.—Brake, Reed & Company, of Philadelphia, contractors, are ready to begin construction on the new line to connect this city with Wabash, the franchise having been granted.

EATON, OHIO—The Hamilton, Eaton, Richmond & Muncie Railway has been granted a twenty-five-year franchise for the construction and operation of a street railway over the streets of Eaton.

THE EMPLOYÉS of the Union Traction Company, of Philadelphia, have received an increase in wages which amounts to about $300,000 annually. This increase affects between 4,000 and 5,000 employés.

ST. LOUIS, MO.—With the necessary capital and right of way secured, the projectors of a new electric line from Alton, Ill., *via* East St. Louis, expect to begin letting contracts immediately.

EAST ST. LOUIS, MO.—The Union Traction Company, of East St. Louis, granted a franchise last July to build electric roads over all parts of East St. Louis, will increase its capital stock from $50,000 to $500,000.

MT. VERNON, OHIO—Mr. Fred W. Jones, of Mt. Vernon, has secured the contract with the Northwestern Ohio Electric Company to change the entire route of the gorge line, north of Akron, near the Cuyahoga River.

MEMPHIS, TENN.—The promoters of the Knoxville-Sevierville Electric Railway have, it is said, practically decided to make a third-rail system. Bids will be asked for the construction of such a line in a very short time. The road will be about fifty-four miles in length.

SYRACUSE, N. Y.—Permission has been granted to the Syracuse & Oneida Electric Railway to construct and operate a street railway in certain streets in Syracuse. At a recent meeting of the council the time limit of constructing the railroad was extended to July, 1902.

WHITE PLAINS, N. Y.—A franchise has been granted recently to the Yonkers & White Plains Railroad Company. By the terms of the franchise the company is compelled to have its line ready for operation within six months after obtaining the consents of the property owners.

DAYTON, OHIO—A meeting of the officials of the Hamilton, Eaton & Richmond traction line has been held perfecting arrangements for the construction of the line which is to be begun in the spring. The entire right of way has been secured with the exception of the Hamilton franchise, the granting of which is thought to be merely a matter of time.

PHILLIPSBURG, PA.—With its capital of $5,000,000 the electric railway company recently organized, and in which Governor Voorhees is interested, is planning to bridge the Raritan River. The system will connect Elizabeth and Newark, and it is expected that it will be extended to Red Bank and connect with the line along the Jersey shore to the coast resorts.

GRAND RAPIDS, MICH.—It is stated that the officers of the Grand Rapids, Kalamazoo & St. Joseph Traction Company are considering the extension of the lines from Benton Harbor and St. Joseph through New Buffalo and Michigan City to Hammond, Ind., twenty miles from Chicago. The cars of the company would then enter Chicago over the tracks of the South Chicago road.

ATLANTA, GA.—A charter has been granted by the Secretary of State to the Savannah Electric Company, capitalized at $3,500,000. The charter consolidates all of the street car lines in Savannah under one company. The incorporators are George Baldwin, W. A. McCall, J. R. Anderson, A. Minnis, W. D. Davis, W. Alexander, C. B. Kidder, L. M. Boggs, H. S. Purse, of Savannah, and G. O. Negley, of Chicago, Ill.

WILMINGTON, DEL.—Arrangements are being made for organizing a company to be known as the Wilmington & South Delaware Traction Company. The purpose of this company is to control the Wilmington & Newcastle and the Newcastle & Delaware City Railway companies. It is planned also to build extensions into Maryland. The Delaware Corporation Company has charge of the formation of the new company.

PITTSBURGH, PA.—Officers of the Pittsburgh, McKeesport & Connellsville Railway Company expect to open their new electric road from Pittsburgh to Fairchance in April and will operate the suburban cars from Pittsburgh over a system of 130 miles, reaching many towns throughout the coke region. The line will enter Pittsburgh over the tracks of the Monongahela Traction Company. The total cost of the road is said to be about $3,000,000.

BENTON HARBOR, MICH.—W. H. Patterson, vice-president of the Grand Rapids, Kalamazoo & St. Joseph Electric Railway now building from Grand Rapids to St. Joseph, and already in operation between Grand Rapids and Holland, states that the road will be extended through to Chicago in direct opposition to the Pere Marquette. It will touch Michigan City and Hammond, Ind., entering Chicago over the tracks of the South Chicago trolley line. The road will be 242 miles long.

ELECTRIC LIGHTING

ALBANY, N. Y.—Assemblyman Adler has introduced a bill for a municipal lighting plant for New York city.

SPENCERPORT, N. Y.—The village trustees are contemplating improved conditions of lighting, and it is understood that electrical illumination is favored.

AUBURN, N. Y.—At a special meeting held recently the stockholders of the Citizens' Light and Power Company voted to increase the capital stock from $30,000 to $250,000.

LEAVENWORTH, KAN.—The Leavenworth Light and Heating Company plant was sold recently to S. Reading Bertron and Richard S. Storrs, of New York. The price is understood to have been $300,000.

POUGHKEEPSIE, N. Y.—The Consolidated Electric Light and Power Company has been granted a franchise to construct and place all the equipments necessary for the business of the company in Poughkeepsie.

COLUMBUS, OHIO—The sum of $500,000 will be spent by the Pennsylvania company in improving and enlarging its shop at Columbus. A new electric light plant, roundhouse and boiler shop will be built.

BALTIMORE, MD.—Lighting service has been extended to West Arlington, Walbrook, Forest Park, Calverton, Waverly and Locust Point. Superintendent of lamps and lighting Robert J. McCuen plans further extensions.

NORFOLK, VA.—At Alexandria United States District Attorney Allan has asked United States Judge Waddell to appoint a receiver for the Consumers' Heat, Light and Power Company, of Newport News, upon the petition of G. A. Williams, of Jersey City.

MOLINE, ILL.—The stockholders of the People's Power Company have approved the plans for extensive improvements which were recommended by Secretary S. S. Davis. For this work an expenditure of about $100,000 will be required during the coming year.

CARTARET, N. J.—The Cartaret Electric Light Company and the Central Electric Company are fighting for the lighting of the streets of this town. The Central has had the contract for several years, but stockholders of the local company hope to wield enough influence with the common council to get the contract.

WILMINGTON, DEL.—Mayor George M. Fisher has refused to sign the lighting contracts awarded recently by the Street and Sewer Department. His opposition is directed only against the duration of the franchise and wants the ten-year limit reduced to six years. The Wilmington City Electric Company is to make extensive improvements.

EL PASO, TEX.—The El Paso Electric Company, organized under the laws of New Jersey, has placed on record a deed of trust of $1,000,000 executed to the State Trust Company, of Boston, Mass. This is given as security for a mortgage of like amount covering certain subsidiary corporations belonging to the El Paso company, which owns and controls all the electric lighting and power plants centering in El Paso, Tex.

ELECTRICAL SECURITIES

The developments of the week ending January 11 show a slight decline in the average price of active stocks, twelve industrials falling from an average of 64.25 to 63.85. The United States Steel stocks were quite active during the week, but as the quarterly statement was not up to expectations, considerable realizing sales resulted and declines amounted to about 3 points.

The statement of the bank of the New York Clearing House shows a gain in surplus of $5,442,875, making the surplus now $12,958,450. A year ago it was $22,398,050. In 1900 it was $16,707,350, and in 1899 it was $28,263,075.

ELECTRICAL SECURITIES FOR THE WEEK ENDING JANUARY 11.

New York:	Closing.
Brooklyn R. T.	66¾
Con. Gas	217¾
Gen. Elec	279
Man. El	139⅛
Met. St. Ry	163½
Kings Co. Elec	185
N. Y. & N. J. Tel. Co	169
Telep., Tel. & Cbl. Co	5

The evident success of the electrical equipment on the Manhattan Elevated caused an increase of several points in the value of the stock. It is expected that material reduction in running expenses, as well as an increase in patronage, will result.

Stockholders of the American District Telegraph Company will hold a special meeting January 23 to vote on a proposition of the directors to reduce the capital stock from $4,000,000 to $2,000,000. The idea was suggested by General Eckert, and it is likely that the proposal will be carried.

Philadelphia:	Closing.
Elec. Co. of America	6⅛
Philadelphia Elec	3⅜
Union Traction	32⅝
United G. I. Co	115
Elec. Stor. Bat. c	60
Elec. Stor. Bat. pf	60

There was quite a decline in Philadelphia Electric securities on Saturday, January 11. The bonds were down to 53¾, a drop of 7 points, and stock down to 3⅜, a loss of about a point. Other stocks on the local market remained about the same. Union Traction is strong in the belief that conflicting transportation interests in Philadelphia will get together.

Boston:	Closing.
Am. Telep. & Tel	160½
Edison Elec	250
Erie Tel. Trust Receipts	18½
New Eng. Tel	140
Mass. Elec. pf	92½
Westing. Mfg. pf	90

Chicago:	Closing.
Central Union Tel	40
Chicago Edison Light	160
Chicago Telep	215
Metropolitan El. pf	91
National Carbon	19
National Carbon pf	83
Union Traction	10
Union Traction pf	47

TELEPHONE AND TELEGRAPH

ATHENS, PA.—The Valley Telephone Company has been granted an extension of sixty days in which to complete its system.

VANCEBURG, KY.—Wires are being stretched for a telephone line between here and Tolesboro, this county. This will give Vanceburg connection with the "Bluegrass" country *via* Maysville.

SIOUX FALLS, S. D.—A company has been organized and will be known as the Citizens' Telephone Company of Sioux Falls. This company will install a central energy system very shortly.

MIDDLEBURG, KY.—A telephone line is in course of erection from London to Burning Springs, Clay County, and when completed that county will be in telephonic communication with central Kentucky points.

INDIANAPOLIS, IND.—The New Telephone Company is to erect a new brick exchange to accommodate 1,000 subscribers of the South Side. A new exchange is also proposed for the patrons on the North Side.

BINGHAMTON, N. Y.—The system of the Inter-Urban Telephone Company, recently incorporated with a capital of $250,000, is to make extensive connections throughout upper New York, beginning at a point near Albany.

BUFFALO, N. Y.—The stockholders of the Frontier Telephone Company have accepted the franchise granted by the common council, and a committee was appointed to select an engineer and a general manager to install an independent system.

DETROIT, MICH.—A. M. Hanbrich, an electrical engineer, and another expert from the Stromberg-Carlson Company have been called here to meet with the Mayor and a special aldermanic committee in reference to constructing a municipal plant.

AURORA, ILL.—At a meeting of the stockholders of the Northwestern Telephone Company at the general offices in this city recently, it was decided to consolidate with the Inter-State Independent Telephone and Telegraph Company of New Jersey by a unanimous vote.

HAGERSTOWN, MD.—The Pennsylvania Telephone Company has commenced construction of a line to Ringgold, Md., and contemplates rebuilding the entire trunk from Waynesboro to Newville, connecting with the new line from Harrisburg, Pa., to that point, with other improvements.

MILWAUKEE, WIS.—The joint committee of judiciary and finance has decided to indefinitely postpone action upon the applications for franchises of the Milwaukee Telephone and Telegraph Company and the Citizens' Telephone Company. The application of the Great Western Telephone and Telegraph Company will likely be recommended for passage by the council.

SCHENECTADY, N. Y.—The new Home Telephone Company will be in operation soon. The local capitalists interested in this company are: A. M. Vedder, Charles F. Veeder, Charles E. Palmer, Richard T. Lomasney and George M. Bostwick. The articles of incorporation, filed with the Secretary of State some time ago, show the amount of capitalization of the company to be $225,000.

NEW INCORPORATIONS

PEORIA, ILL.—The Citizens' Telephone Company. $50,000.

CAMDEN, N. J.—The Interstate Lighting Company. $125,000.

JONESBORO, ARK.—People's Light and Power Company. $20,000. Directors: H. H. Houghton, R. H. Meyers and others.

PUEBLO, COL.—Pueblo Water Supply and Power Company. $500,000. Incorporators: James H. Brown, J. C. Craig and others.

ITHACA, N. Y.—Ithaca Telephone Company. $75,000. To operate a telephone line in Ithaca and other places in Tompkins County.

HARTSHORN, I. T.—Indianola Ice, Light and Power Company. $50,000. Directors: C. W. Dawley, H. W. Adams, H. F. Jeffers and others.

BERLIN, CT.—Berlin & Bridgeport Electric Street Railway Company. $50,000. To build a line from Berlin to Bridgeport, one and a half miles.

PIPESTONE, MINN.—The Southwestern Minnesota Telephone Company. Filed amended articles of corporation fixing the capital stock at $150,000.

WINNIPEG, MANITOBA—The Manitoba Water Power Electrical Company. $500,000. Manitoba charter. Incorporators: H. B. Burkholder, N. T. Leslie, William Gerogeson and others.

ROCHESTER, N. Y.—The Municipal Gas and Electric Company. $2,500,000. To operate in the entire county of Monroe. Directors: Anson R. Flower, C. K. G. Billings, of New York city, and H. C. Brewster, of Rochester.

FOND DU LAC, WIS.—The Fond du Lac & Oshkosh Electric Railway Company. $100,000. To build an electric railway through the towns of Fond du Lac, Friendship and Eldorado, Black Wolf, Nekinn and Oshkosh. Incorporators: George A. West, George Lines and others.

INDIANAPOLIS, IND.—The Indianapolis, Nashville & Southern Transit Company. $200,000. To build a line from Indianapolis to Nashville, through the counties of Brown, Marion, Johnson and Morgan. Incorporators: F. A. Gentle, Dr. G. B. Martin and B. F. Nysewander.

CINCINNATI, OHIO—The stockholders of the Cincinnati Gas and Electric Company have voted to ratify the proposition of the directors to increase the capital stock of the company $1,000,000. The total capital is now $29,000,000. The new stock will be paid out for improvements.

NEW YORK, N. Y.—Bristol Gas and Electric Company. $300,000. To manufacture gas and electricity for illuminating and other purposes. Directors: B. L. Delaney, of Bristol, Tenn.; Anson McC. Beard, John D. Fearhake, Frank B. Pierce and Frank M. Wells, of New York city.

ELIZABETH CITY, N. C.—$125,000. To construct and operate an electric street railway in Elizabeth City and adjacent country, and to furnish electric current for lights, power, etc. The paid-up capital is $20,000, and the subscribers to stock are: J. A. Wallace, of Berkley, Va.; J. G. Wallace, of Wallaceton, Va.; W. C. Ferebee, of Norfolk, and C. M. Ferebee, of Elizabeth City.

INDUSTRIAL ITEMS

WILLIAM J. MURDOCK & COMPANY; Chelsea, Mass., will be pleased to send their catalogue relative to the several styles of telephone receivers which they manufacture.

THE STANLEY ELECTRIC MANUFACTURING COMPANY, of Pittsfield, Mass., is sending out a miniature transformer made of aluminum, making a very convenient desk match safe.

G. A. MCINTYRE & COMPANY, Stamford, Ct., manufacture an electric staple driver especially handy for electricians' construction work, as it may be used with several sizes of staples and operated in the dark.

THE ASHTON VALVE COMPANY, Boston, Mass., manufacturer of the Ashton "Pop" safety valves, pressure and vacuum gauges, is adding to publicity with an illustrated hanger and calendar for the new year.

THE AMERICAN ELECTRICAL WORKS, Providence, R. I., manufacturer of bare and insulated electric wires, exhibits a handsomely embellished lithograph of Volta on its new calendar. The New York office is at 26 Cortlandt street.

FRED M. LOCKE, Victor, N. Y., manufacturer of porcelain insulators for all electrical potentialities, manufactures a special porcelain telephone insulator which is claimed to be stronger than glass for telephone construction work.

THE NUNGESSER ELECTRIC BATTERY COMPANY, Cleveland, Ohio, is soon to move into a large new building erected for the manufacturing accommodations of this company. This company manufactures dry batteries for the various services.

THE MALTBY LUMBER COMPANY, Bay City, Mich., offers poles for telephone, telegraph or electric light service, and in view of its being located in the lumber regions of Michigan, its facilities are excellent for prompt and careful shipments.

THE SIGNALOID CHEMICAL WORKS, Jersey City, N. J., manufactures a proprietary compound known as "Signaloid" for the coloring and frosting of incandescent lamps. It is said that this compound does not peel, chip or crack after application.

THE IMPROVED PRIMARY BATTERY COMPANY, 594 Broadway, New York, is now manufacturing the Baines primary battery for telephone service, or for any purpose requiring a constant current. Strong claims are made for the efficiency of this battery.

MR. R. B. BRAMWELL, who has been associated with the DeDion Bouton Motorette Company, has accepted the management of the publication department for the International Motor Car Company, of Toledo, Ohio, succeeding Mr. W. C. Stuart.

THE ELECTRIC CONTROLLER AND SUPPLY COMPANY, Cleveland, Ohio, reports a most active year for the period just closing, and that it is about to enlarge its facilities to meet the growth of its business. The company makes electric controllers for all degrees of service.

THE VARLEY DUPLEX MAGNET COMPANY, Phillipsdale, R. I., and Fisher Building, Chicago, is issuing catalogue No. 6 descriptive of telephone magnets. This company is exclusive manufacturer of the Varley automatic machine-wound magnets in either insulated or bare wire coils.

THE INTERNATIONAL TELEPHONE MANUFACTURING COMPANY, Chicago, Ill., of which Mr. Henry Shafer, well known in the telephone manufacturing field, is president, is soon to place before the telephone industry the embodiment of the most advanced ideas in exchange telephone apparatus.

THE LINCOLN ELECTRIC COMPANY, Cleveland, Ohio, offers for sale at most reasonable prices six dynamos of various makes, including Rockford, Edison and Walker machines, of from one to seventy-five kilowatts; also four motors from one to fifteen horse-power, of Jenney, Edison and other makes.

THE GLOBE AUTOMATIC TELEPHONE COMPANY, of Chicago, is erecting exchanges in the towns of O'Neil, Neb., Crystal Lake and Elsworth, Minn. The company is daily receiving enquiries about its automatic system from all parts of the country, and the exchanges which have already been installed are giving entire satisfaction.

THE C. W. HUNT COMPANY, West New Brighton, N. Y., has issued catalogue No. 0117 in which its steam hoisting engines are described. These engines are beautifully illustrated throughout the catalogue and it should be of use to any one who is contemplating the purchase of such machinery. These engines are massive in construction and have been designed especially for heavy duty in continuous service.

THE HELIOS-UPTON COMPANY, which has recently completed its H-U alternating system for arc lighting, fully described in the ELECTRICAL REVIEW recently, is receiving unusual commendation from engineers as to the desirability of this new system. The compactness of the regulator claims especial attention, and it is designed to be used directly on the primary circuit without transformation, if desired.

THE PROTECTORATE COMPANY, 21 Quincy street, Chicago, announces that it has perfected a high-grade liquid insulation which will be sold under the name "Protectorate." The company claims that for cutout boxes, arc lamp spools, transformers, armatures and field magnets, and for street railway motors it has discovered the ideal insulation, one which has stood the most trying tests to which it could be subjected.

FOR INVENTORS—We have received a pamphlet entitled, "How to Obtain Patent, Trade-mark and Copyright Protection, with Decisions in Leading Patent Cases," published by E. G. Siggers, of Washington, D. C. The pamphlet contains, among other things, a map of Washington, and is replete with valuable information to inventors. A copy of it can be obtained free of charge by addressing E. G. Siggers, 918 F street, N. W., Washington, D. C.

THE JOHN A. ROEBLING'S SONS COMPANY, of Trenton, N. J., is sending out a very neat and comprehensive catalogue of some seventy-six pages, illustrating and describing in detail the varied and excellent products of this great manufacturing house. This catalogue will be sent on request made to the home office, or to any of the branch offices located at 117 Liberty street, New York, 171 Lake street, Chicago, and 25 Fremont street, San Francisco, Cal.

THE AMERICAN ELECTRIC FUSE COMPANY, of Chicago and New York, has recently opened at Atlanta, Ga., a southern office and stock rooms in which will be carried a complete line of American specialties, embracing fuse wire, telephone fuses, lightning arresters, Rolfe protectors, wire connectors and other electrical specialties manufactured by the company. The American Electric Fuse Company is one of the largest manufacturers of protective apparatus in the world, and gives employment at its factory to over 200 workmen.

THE ALLIS-CHALMERS COMPANY, of Chicago, Ill., is distributing the sixth edition of catalogue No. 2. The book contains 125 pages, and is replete with information and illustrations relating to hoisting engines and appliances. Many tables of sizes and weights of its machinery and appurtenances also appear, and sectional and elevation drawings, as well as engravings of standing mechanisms are shown. The catalogue is substantially bound with a gray cover, embossed in green, and is very conveniently handled, opening out flat.

THE ELECTRICAL ENGINEERING COMPANY, San Francisco, Cal., has purchased the factory of the defunct Pacific Incandescent Lamp Company, and announces that it has begun the manufacture of incandescent lamps on a scale never before attempted west of the Mississippi. In addition to "refilled" or "renewed" lamps, which bear the label "Pacific," as heretofore, the company will manufacture an entirely new lamp known as the "California." Mr. Charles F. Sloane, Mills Building, San Francisco, is the general sales agent for this company.

THE AMERICAN BLOWER COMPANY, of Detroit, Mich., is attracting attention to a line of "A B C" hot-blast heaters, with a splendidly illustrated twenty-four-page catalogue. The "A B C" heater is a sectional base heater, and is said to be a radical departure from the stereotyped form of construction, possessing a great adaptability for combination with fans. The "A B C" hot-blast apparatus is used to heat large buildings, and is also employed for drying purposes. The company also manufactures a large variety of exhaust fans, kiln apparatus, and vertical, horizontal, automatic and throttling governors.

OBITUARY NOTICES

MR. CHARLES E. BARNES, of Boston, Mass., well known as a capitalist and heavily interested in electric railroads, died suddenly in the North Station on January 3, at noon.

MR. MARCELLUS HARTLEY, of New York, dropped dead at a meeting of the executive committee of the American Surety Company, on Thursday, January 9. Mr. Hartley was very prominent in commercial and financial affairs, and was a director of the Westinghouse Electric and Manufacturing Company.